ENGINEERING NEWS

THE Building Fund subscription of the American Society of Civil Engineers has increased from $7,810 to $8,085, as elsewhere reported. It must be confessed that it does not grow very fast, which is greatly to be regretted, as a generous subscription now would ensure the procurement of a larger building, such as the Society is sure to need soon, even if the present building be enlarged as proposed. As the total number of subscribers is still small, those who have not yet "chipped in" will undoubtedly be gratefully heard from. The Committee in charge of the matter hope to secure some large outside subscriptions, we believe, if the Society itself responds liberally.

A FINE deposit of rock salt, 96 per cent. pure, has been discovered at Ellsworth, Kan., in a vein 165 ft. thick, encountered 705 ft. below the surface. From samples of the borings received at this office, the salt appears to be discolored on the edges of the vein, but in the middle a pure white, requiring grinding only, to be fit for the table. The 4 per cent. of impurities (which appear to be chiefly in the exterior of the vein), consists only of magnesia and lime, with no trace of potash, so that it would hardly appear necessary to do more than grind the salt to fit it for table use. Taking in view the purity of the salt and the short distance below the surface, this should make one of the most valuable deposits ever struck. The supply appears to be inexhaustible, and great excitement over the find prevails in Ellsworth, as might be expected.

THE St. Louis *Globe-Democrat* says that the indications are that the FLAD system of conducting electric wires will be given a test in that city. This is the same tower system (overhead) that is being erected in New Orleans and lately described in this journal. The St. Louis plan proposes to set these towers from 400 to 1400 ft. apart with the standards running from the four corners of the street and of a height sufficient to clear with the cables the ordinary high buildings. Objections have been made from an æsthetics tand point, but Col. FLAD says it would be much less objectionable than the poles it would supplant. Its use as a stand-pipe at each street corner for fire-purposes is a good supplemental feature. The franchise has yet to be secured.

WORK on the Hudson River Tunnel has been partially suspended for a time. No work is being done in the heading, but the air compressors are kept running to maintain the pressure in the tunnel. The trouble, we believe, is financial, but whether from lack of funds or difficulty with capitalists we do not know. It is to be regretted that the work should be stopped at this time. During the past three months an average of between 3 lin. ft. and 4 lin. ft. of completed tunnel has been made each day. The silt passed through was remarkably homogeneous and free from sand pockets. The men had become familiar with their duties and accustomed to the pressure, so that the "heads" were not frequently heard from. The heading of the north tunnel, the only one of the four which has been worked lately, is now 1840 ft. from the shaft or just one third way across the river. We trust that operations will be resumed soon.

THE usually dry region of southern Arizona and northern Mexico has just experienced a very heavy and disastrous rainfall. The Mexican Central and Southern Pacific were the principal sufferers, and all along the line of the latter from Yuma to Tucson washouts are reported. Between Tucson and Benson the damage was greatest, two large bridges being carried down and large sections of the roadbed swept entirely away. One report states that steel rails were carried a quarter of a mile down the river. We have not computed the theoretical velocity of current required to erode a surface composed of steel rails, but we venture to ascribe this last statement to the reporter's vivid imagination.——On the Northern Pacific near Rosebud, Montana, heavy rains caused a landslide which struck a freight train and carried the engine and four cars down a twelve foot embankment.

THE most serious accident of the week occurred on the Chicago, Burlington & Quincy near Afton, Ia., September 7, at 2 P. M., and consisted of a rear collision of a westward bound passenger train with a fast mail following. Two persons were killed and two fatally injured. The coroner's jury rendered a verdict charging the conductor and flagman of the passenger with criminal negligence, but with most such accidents the most criminal negligence lies back of the unfortunate trainmen who forgot themselves at the wrong time, with the system of management which has no adequate safe guards against such inevitable negligence.

THE signal service station on Mount Washington is to be discontinued. It has proved of interest in watching atmospheric changes at that point, but the observations are of little or no practical value to the rest of the district, as the altitude is so great that the changes there rarely effect the lower regions. It is possible that it may be run from May to September, but it is a needless expense in Winter and a very uncomfortable place for the operators.

THE Aqueduct Commission on Sept. 14 extended the time in which O'Brien & Clark and Brown, Howard & Co. were to complete their work on the aqueduct tunnel, to eight months from Sept. 20. This extension is due to unforseen obstacles and the determination to line the tunnel with brick after the original contracts were awarded.

UNFORTUNATE Shaft No. 17 on the New Croton Aqueduct was the scene of an accident on Friday of last week which cost three lives. At the time mentioned the contractor, Mr. BRANCHAUD, Resident Engineer THOMPSON and 15 men were in the heading when, without a warning sign, there was a crash of timbers and an inrush of sand, gravel and water that buried three men outright, while the remainder had a very narrow escape. The run filled the tunnel almost to the roof for about 20 ft. back of the face. No cause is yet given for the accident.

IN spite of Baron HAUSSEMANN'S blunt refusal to entertain a proposition for street railways, as made by the famous GEORGE FRANCIS TRAIN in 1860, Paris now has about 120 miles of tramways, and France has over 1,200 miles in her various cities and towns. Some of these roads have cost inordinate sums to their original stockholders, and the *Cie des Tramways Sud*, of Paris, is an example. This road was organized in 1875, and has just been bought by an English company for one-half of the 27,285,000 francs spent on its 40 miles of line, or nearly $125,000 per mile. The original *concessionaire* was the lucky fellow in this case, as he sold his privileges for $580,000 cash and nearly $2,000,000 more in paid shares and bonds, and then acted as contractor to build the line. The road was wrecked in 1882, either by gross mismanagement or deliberate intent, whereby the running expenses were advanced from 77 per cent. of the receipts in 1876, to 95.2 per cent. in 1881.

CERTAIN "scientific men," according to Mexican dispatches, are beginning to study certain meteorological phenomena which they believe to be due to the construction of railroads in that country. Washouts of a serious character on the Mexican Central R. R. are charged to waterspouts "attracted by the rails and telegraph wires." And another report has it that as fast as construction advanced on the Gaudalajara branch of the Mexican Central, rain followed. With the country dry in advance, "rain beats down in buckets full just where the steel rails are loaded on the construction trains, but only in circles a few miles in diameter." !! The effect of railways upon rainfall has been noted and speculated upon in sections of our country, especially in the West. But we have never heard of any scientific investigations of what may be only a coincidence.

SAN FRANCISCO papers say that the most of the ferry steamers of the Southern Pacific R. R. are being fitted to burn petroleum instead of coal. At $1.65 per barrel for petroleum the saving was 10 per cent. as compared with coal, and the oil is now lower, only costing $1.45. There is also less wear and tear on the boilers and the services of one or two firemen can be dispensed with. The oil is sprayed by a steam jet.

THE stockholders of the Toledo, Peoria & Western are to meet at an early date to discuss and consider their liabilities for the Chatworth disaster. Full damages in each case, it is said, would involve a clear loss of over $1,000,000.

AT the Manhattan bridge over the Harlem river, in this city, the massive skew-backs for the east side of the shore-span are set and those for the river side of the same span are being put in place. Much of the falsework for this shore-span is now up.

TO-DAY is the date set for the meeting of the International Railway Congress at Milan. Sixteen nationalities will be represented at this Congress, controlling about 74,000 miles of railway and 140 separate administrative departments. Some 300 members will attend at Milan. The last Congress was held in Brussels in 1885.

Le Bulletin du Canal Interoceanique, for Sept. 9, gives the July cube of excavation on the Panama Canal as 911,000 cu. m., 339,000 cu. m. being on *derivations*. The rain has interfered with the pushing of work.

Sir EDWARD WATKINS is again agitating the question of a tunnel between the Mull of Cantyre, in Scotland, and Fair Head in Ireland. These points are only 10 miles apart, but the English press questions the sufficiency of traffic to pay interest on the investment.

MILAN, Italy, is discussing an underground railway to connect its principal stations on incoming roads.

THE New York, Lake Erie & Western has had bad luck with its new block signals, according to report, a great deal of inconvenience and delay having resulted in the first two days, so that the system was temporarily abandoned. We anticipate, however, that the reports are very much exaggerated.

THE Manitoba railroad quarrel still goes on actively and it is hard to see just what the opposing positions are or what is likely to be the immediate result, "but then the quarrel is a very pretty quarrel as it stands, and we should only spoil it by trying to explain it," while the ultimate outcome is not doubtful.—complete defeat of attempts to impede industrial development from political motives.

REPORTS from Ecuador say that the Bahia de Caraques and Quito railway will, in all probability, soon be under construction.

THE New York, Lake Erie & Western R. R. has adopted and put into practice the block system of railway signals. The change will effect the main line of the Erie, the Newark branch, the N. Y. & Greenwood Lake R. R., the N. J. & N. Y. R. R., and the Northern R. R. of New Jersey.

THE past week has been an eventful one in Northern Pacific circles. There has been a sharp fight for the control of the road between the present management, headed by President ROBERT HARRIS, and a syndicate of which ELIJAH SMITH, President of the Oregon Railroad & Navigation and Oregon & Transcontinental companies; CHAS. L. COLBY, President of the Wisconsin Central, and HENRY VILLARD are principal members. Before the election, however, the leaders of the opposing factions held a conference, counted up their proxies, and agreed upon a compromise ticket for the directorate. The new members which were chosen are, besides Messrs. VILLARD and COLBY, EDWIN H. ABBOTT, COLGATE HOYT and JOHN B. TREVOR. The important moves that are indicated by this change in the board's make-up are a joint lease of the Oregon Railway & Navigation Company's lines with the Union Pacific, harmony with that company upon the matter of competing extensions, and last and most important, a close alliance with the Wisconsin Central system which can hardly fail to prove of great mutual advantage to the contracting parties. A matter of great interest is the return of Mr. VILLARD to a prominent position in this company where he once was at the head but was so suddenly dropped, as it was then supposed, into permanent oblivion.

Roadmaster J. O'BRIEN, of the Illinois Central R. R., is authority for the statement that the use of stone ballast on that road has prolonged the average lifetime of ties from 7 years to 12 years. The prevalence of Hungarians and Italians, as repairsmen, in place of the old time Irishmen, is said to account for the frequent late loss of life on that line. The new arrivals are charged with not possessing common sense enough to get out of the way of a coming train.

THE City of Boston has been gathering late mortality statistics of principal American cities and the result shows an alarmingly high rate as compared with the first six months of 1886. Dr. MCCONNELL'S table is as follows:

	Total Deaths		*Children*		*Preventable.*	
City.	1886.	1887.	1886.	1887.	1886.	1887.
Boston....	4,327	4,613	1,244	1,479	534	615
New York.	17,084	19,026	6,648	8,052	3,516	4,487
Chicago....	6,558	7,488	3,131	3,684	1,373	1,735
Brooklyn..	7,279	7,755	2,811	3,166	1,222	1,549
St. Louis..	3,732	4,220	1,499	1,705	785	956
Cincinnati	3,361	3,756	——	1,573	705	896

This shows that in the six cities named there has been an increase of 4,247 deaths in the first six months. The children in the table are under 5 years of age. For the five weeks ending June 30 the deaths in Boston were at a rate equivalent to 30.40 per 1,000; 48 per cent. of these deaths were of children under 5 years, and 31 per cent. were due to preventable causes. The rate in New York for the same period was 36.82 per 1,000; and the children made 59 per cent. of the total mortality, and 43.6 per cent. were chargeable to preventable diseases. In Brooklyn the rate was 36.58 per 1,000; 62.1 per cent. being children. In Philadelphia 51 per cent. of a very high total were children. In Chicago the July rate was 36.38 per 1,000, and in Pittsburg it was 37 per 1,000. The peculiar atmospheric conditions of the past two months or more are charged with this unusually heavy mortality rate, and Dr. MCCONNELL says that if it had been due to an infectious disease there would doubtless have been a panic in the country.

SOME weeks ago the newspapers were filled with rumors that the Sante Fé, the Missouri Pacific, and the Rock Island were going to shut down work on their projected extensions in Kansas on account of drouth, hard times, etc., and a consciousness that the State was getting filled with about as large a mileage as its resources would warrant. After croaking dismally over this story and printing alternate denials and affirmations of it for some weeks, an energetic scribe suddenly pops up and exclaims that the "true inwardness" of the rumor has just come to light. He declares that the report was started by the companies themselves for the purpose of scaring off investors in the independent railway enterprises of Kansas, of which, "if one-tenth of the schemes now projected are successful, that State will within a few years be the scene of very lively warfare, and the guerilla companies will by no means be at the mercy of the old lines."

The story is a good one as a story, but it lacks the desirable merit of probability. Last year nearly 1700 miles of track were laid in Kansas, and the fraction of this not directly laid by or for the great systems is so small that it may be neglected. This year since Jan. 1, we have records of something over 20,000 miles of projected railroad originated by Kansans and progressed far enough to file charters with the Secretary of State. This does not signify, however, a stage sufficently advanced to cause *much* alarm to holders of Sante Fé or Gould stock. In short, the idea that these visionary schemes, which never amounted to anything and never will, are taken into account by the railway managers in making up their "bull" or "bear" rumors, is a story so idiotic that its originator deserves a leather medal. It would not be far from truth to say that a greater railroad mileage is chartered in Kansas every year than in any other half dozen States combined, while the mileage actually built and operated by independent companies is practically nothing. We think that if the fee to the Secretary of State for recording charters was fixed on a *per mile* basis—a few cents per mile would probably do—that it would effectively pare down the enthusiastic enterprise of the professional Kansas incorporator and save us much trouble in mapping his vast schemes.

Natural Gas, its Occurrence and Application in Pittsburg.*

[A Lecture before the North German Iron & Steel Association at Osnabrück, Germany, by KURT SORGE, M. E., Translated by J. H STELLMAN.]

(*Concluded from page 185.*)

The piping of gas into Pittsburg and its immediate surroundings, is attended with great expense, as, a large number of the wells are from fifteen to twenty-five miles distant, and as, according to an estimate before me, the friction reduces the pressure about 7 lbs. to the mile; a pressure of 200 lbs. to the sq. in. per mile at the well, would have no pressure left at a distance of thirty miles in 12-in. pipes; the question of piping is therefore one of great moment. The conduit pipes are made of wrought-iron, manufactured in pipe tube works in or near Pittsburg. The diameter of the wrought-iron pipes runs as high as 16 in. and as low as 3, the most, however, have 8-in diameter, which also applies to the pipe line conducting gas from the Edgar well, (which I visited), to Pittsburg, some eighteen miles distant; this line is intended to take up some six or eight other wells besides the Edgar; the diameter of the pipe is 8 and 12 in., and the cost was named to me as about $8,000 average per mile. Gas lines, however, under certain circumstances, will average as high as $12,000 per mile, as the owners of property along the line sometimes charge exorbitant prices for the right-of-way. Pipe lines are usually laid from 2 to 4½ ft, below the surface, except at the river crossings of the Allegheny and Monongahela, where they are laid under the bed of the rivers.

Two parallel lines have been laid by the aforesaid company 2 ft. apart, and the pipes are connected, by a system of switches, every five miles and provided with gate valves, to enable the shutting-off of any break; the gas can be switched off from the broken parts to the opposite side, and turned back again into the next switch while the break is being mended. The principal lines also have escape pipes in the city about 50 ft. high, which are provided with automatic escape valves for regulating the pressure. There are also stations along the line, and the connecting lines at each of these are governed by valves, through the operations of which the pressure may be increased or diminished, at the command of the central office, where the general superintendent directs all movements; the pressure hereby requiring more or less alteration according to the varying demands. The companies are also provided with a system of telephone lines for expediting their business. The pressure in Pittsburg is not allowed to exceed 15 lbs. per sq. in. in the city limits, and gas is therefore regulated by ingenious devices and contrivances on its entry into the same, and the surplus gas is turned off on public squares or unobstructed places, and allowed to burn day and night from escape pipes, about 6 in. wide and 30 to 50 ft. high. This limit to the pressure was fixed because high pressure in the past had often caused leaks, and the accumulations of gas from them in cellars of dwelling houses had repeatedly occasioned dangerous explosions, the more so, as natural gas is almost odorless, and the danger of explosion, when brought in contact with air is greater than with artificial gas. The greatest explosibility, according to experiments of the Engineers' Society of Western Pennsylvania resulted at a mixture of one volume of gas to ten volumes air.

Regarding the fuel value of natural gas, we have the following from Professor J. P. LESLEY, State geologist of Pennsylvania:

One pound of coal equals in weight 25 cu.ft.of gas. One pound of coal has a fuel value of 7½ cu.ft. of gas. A committee of the Engineers' Society of Western Pennsylvania, reported that a boiler which evaporated 9 lbs. water with 1 lb. of coal, evaporated 20.31 lbs. water with 1 lb. of gas; allowing 23¾ cu. ft. to 1 lb. gas, we have, 1 lb. gas equal to 2.255 lbs. of coal, and 1 lb. coal equal to 10.04 cu. ft. of gas, for evaporating water; but as the boiler used did not quite satisfy the committee as to economic results, say 7½ cu. ft.

The theoretical value of gas as compared with coal is stated in the report of S. A. FORD, chief chemist of the Edgar Thompson Steel Works, at 210,059,604 heat units in 1000 cu. ft. gas, weighing 38 lbs. while the same weight of carbon contains 139,398,896 heat units; therefore 1000 cu. ft. of gas are equal to 55 lbs. of coal—showing the value of natural gas as a fuel to be much greater than coal. During the time of my sojourn in Pittsburg last summer the application of natural gas to domestic and manufacturing economy was developed to a remarkable extent, and by this time has doubtless made further strides. At or near the wells, it is, as already stated, used principally for heating derrick boilers and for furnishing oil pumps with power. In the Canonsburg district a net work of pipes 25 to 30 miles in length had been laid, which supplied seventy oil wells with power, at a cost of $2.50 per day; this being a surface line, and comparatively of moderate cost, this revenue in itself was considerable. The towns of Washington and Canonsburg are also furnished with natural gas, for both illuminating and heating purposes, and the schedule was as follows:

Cooking ranges, $1 per month; heaters and stoves, 75 cts. per month; burners, 15 cts. per month.

These are extremely low prices, particularly when it is considered that the quantity of gas used is not limited, but can be used *ad libitum*, no meters being in use. Stoves or ranges, especially adapted for gas are very uncommon. The ordinary ranges, stoves and fire-places were adapted to its use by leading a perforated pipe into the fire-place or stove, and covering it with some fire-proof substance, such as fire brick, which would absorb and retain the heat.

The prices in Pittsburg were somewhat higher than those just quoted, and were generally estimated by the cubic dimensions of the dwellings or plant to be supplied, as at that time no fixed scale existed, and business was done by contract. A director of a large corporation told me that he paid $95 annually for heating his elegant country villa, inclusive of green houses, stables and outbuildings. The proprietors of the Duquesne Hotel, where we stopped, paid $560 annually for heating their entire hotel, consisting of seventy bed chambers, bath arrangements, laundry, kitchen and bakery. Gas was not measured in any way last summer, but the companies expected to introduce meters and furnish gas at 6 to 7 cts. per thousand cubic feet.

In order to give a clear idea of its application to manufacturing purposes, I propose to give a few examples, illustrated by sketches, but must first state that the opinions regarding the most economic application of gas, particularly as regards the pressure to be used, are very conflicting, and, that I was astonished beyond measure to see the different systems of pressure under which manufacturing was conducted; there was then, however, a general inclination to the belief that too great a pressure, aside from its wastefulness, had a heat lessening tendency.

Heating the air to 2,000° F., a chemical proportion of one volume of gas to eight volumes air, and a pressure of 2 oz. in connection with which a ⅜ to ½ in. feeder will suffice for a large furnace, were frequently cited to me as favorable conditions. Messrs. SPANG, CHALFANT & Co. and GRAFF, BENNETT & Co., of Pittsburg, are entitled to the credit of being the first to apply natural gas to economic use in Pittsburg. They piped gas from a distance of fifteen miles as far back as 1875, without betraying the advantage which they derived from its use. At the present time there is hardly a glass works or furnace not availing itself of this excellent fuel.

One of the glass works which we visited had a pressure of 7½ oz. in its principal main, while the separate furnaces only indicated a pressure of 1 oz. to the square inch. The glass furnaces here consisted of a group of fourteen stationary pots, arranged in circular order in a furnace, each of the capacity of about 4,000 lbs. of glass. This furnace was supplied with a distributing gas-pipe 6 in. in width, from which the gas flowed at a pressure of 1 oz. There was also an appliance connected therewith for spreading out the flames and thus increasing the heat. Two coal teazers in each gang were formerly required for each furnace at a weekly expense of $34; now only a foreman is required to watch

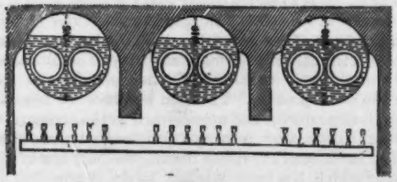


Fig. 5.

the water gauges. Another advantage derived from the use of natural gas is found in the evenness of the temperature, which permits of a more rapid smelting process, and insures a more uniform quality of glass.

I was also informed that in furnaces where the coal gases formerly came in contact with the surface of the glass, the polish was injured by the sulphurous ingredients of the coal; so, that the transparency of glass manufactured from natural gas which is free from sulphur as compared with the former, stands in the proportion of from 8 to 10: 4, or the glass of the latter, is two to two-and-a-half times more transparent.

The cost of gas per month in these works was $28 for each pot, about the same as the value of coal formerly used in the smelting furnaces, and includes the price of gas used in heating boilers and tempering ovens; so that the wages of the coal teazers is a complete saving. On visiting the steel barbed wire works of Messrs. SCUTT & Co., I found they had the same low pressure as in the glass works just visited. Their boilers, about 3½ ft. diameter, and 17½ ft. length, were arranged in groups of three; a gas distributing pipe is run directly through the fire chamber, and the heating gases are thrown out under each boiler from six burners. (Fig. 5) which are separately illustrated in the sectional cut,

(Fig. 6). The burners have an escape opening about 1¼ in., but just before reaching this the gas has passed through a contracted tube ¼ in. wide, so that the gas pressure at the escape must be merely nominal, as it was only regulated for one ounce pressure before the contraction: the foreman of the factory told me that this system was one of great advantage. As regards the conducting of the heating gases, a flame strikes out under the boilers and returns through two boiler flues to the front, thence to the chimney. The feeding is similarly conducted. The main feeder is situated in front of the boilers, whence a smaller pipe with gate valve branches off to each furnace; at the head of this pipe, which runs in the same direction as the boilers, a distributing pipe is attached inside the furnace on either side, and the gas either burns through burners, holes or slits in the pipe. The pressure at the water gauge will vary greatly, as instead of 1 oz. as here, I found it as high as 10 lbs. elsewhere.

Fig. 6.

Gas is also in exclusive use in the metal smelting furnaces, and the following examples will show the simplicity of the appliances with which this process is

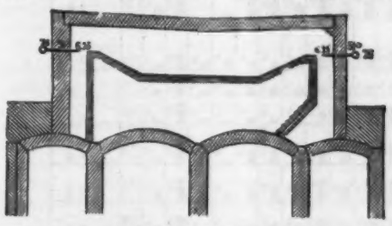


Fig. 7.

conducted. A change in the adaptation of coal furnaces is unnecessary for the application of natural gas. In the factories and works which I visited, I found that Siemens regenerative furnaces, previously in use, were being utilized, the air only was partially heated, and gas was introduced sideways directly under, or immediately over the fire bridge by means of jets. I have been repeatedly informed that the temperature would

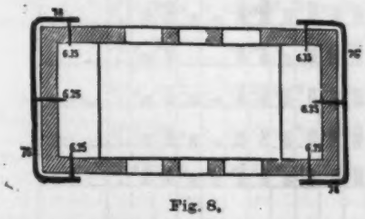


Fig. 8.

be too high in the event of gas also being partially heated before introduction. I believe, however, that the reason for this can only be found in the novelty of the application. Gas was introduced into the Siemens-Martin furnaces which I saw, in the manner shown in Figs. 7 and 8, by three jets on each side, and the width of the distributing pipes to a furnace of ten tons capacity, as seen at the Spang Steel and Iron Co., was three inches, the width of each of the three jets branching off from it was two inches, and the opening at the extremity of the jets was ¼ of an inch wide, with a pressure of 1 lb. per sq. in. In a Martin furnace of fifteen tons capacity, at the Black Diamond Steel Works, the distribution and the size of the jets were the same, but the pressure was 1¾ lbs. per sq. in.

The gas supply of the Union Iron Mills, which have an annual output of 45,000 tons and heat all their furnaces and boilers (thirty-eight puddling furnaces, eight double and four single Siemens furnaces) by natural gas, is brought into the works by two lines of 8-in. pipe. The gas pressure is maintained in the principal main at 1 lb. to 1¼ lb. to the sq. in., and each furnace receives its supply through a 2-in. pipe furnished with an escape valve for regulating the pressure. In single furnaces gas is introduced through five burners ¾-in. wide, at a pressure which varies from 1½ to 2 oz. (see Fig. 9. In double furnaces, 12 ft. deep, eight burners of equal size are arranged on each side.

The clearest impression of the extraordinary significance of natural gas was obtained by me in the most important works of the Pittsburg district, the Edgar Thompson Works, of Carnegie Bros. & Co.; for these splendidly equipped and extensive works, with a daily production of 650 tons of steel rails, do not use a pound of coal with the exception of that consumed in the locomotives. They now have their own gas wells and pipe lines, but during 1884 these works paid the gas companies $120,000. This contract was made on the basis of their average yearly coal consumption for a number of years, and the estimated value was paid to the gas companies. This was to be the price for a period of five years, if I am not mistaken, in which interval it was presumed that the cost of the line would

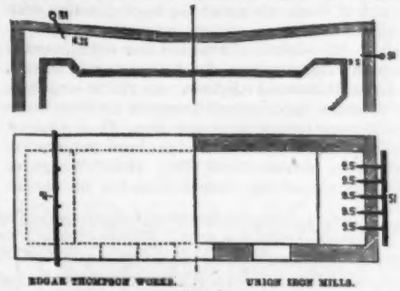


Fig. 9.

be covered. A new contract was then to be made. Even with this high annual tribute, which the Edgar Thompson Works only accorded owing to the uncertainty of the continuation of the gas flow, the direct and indirect advantages derived therefrom were very great, the labor alone of 147 coal heavers and stokers was economized, and on seeing the cleanliness and convenience of the boiler appliances, one is easily convinced that by an indirect saving in wear and tear, the value of natural gas is still further enhanced, without considering its facilitation of the work.

Fig. 10.

The Edgar Thompson Works were the only ones where I saw natural gas used in heating the blast furnace stoves, gas being introduced to increase the temperature where this is too low even under high blast. Gas was not introduced into the furnaces of the rolling-mills sideways under the fire bridge, as previously described, but through the very top of the vault directly over it, and this by means of four ¼-in. jets on each side. The regulator on the main line of the works, during my visit, indicated 70 lbs. pressure to the square inch, but this was unusual, as it seldom runs over 35 to 40 lbs. (Fig. 9, left side) The arrangements for heating boilers in these works will doubtless prove interesting, as they are very unique. As far as I can remember, thirty boilers are arranged in a row, each 4½ ft. diameter, by 28 ft. length. The gas flame is introduced underneath the boiler from whence it is conducted to the front by two return flues. Each boiler has its own fire chamber, and gas is introduced by a 2-in. tube, which branches off from supply pipe in front of the boilers and is supplied with valves for shutting off. At the extremity of this pipe there is attached a burner, (see Figs. 11 and 12) or sort of injector by which the gas is forced in under a pressure of 30 lbs. to the sq. in. through a ¼-in. tubing A, and carrying with it the necessary air for combustion in B, then escapes by a 36-in. slit, C.

Fig. 11.

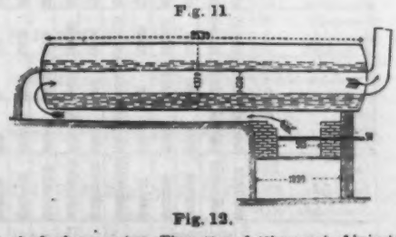


Fig. 12.

The empty fire chamber around the burner is lined with fire brick for the purpose of absorbing the heat and utilizing it to advantage. The entire boiler arrangement makes an imposing impression on first entering it, from the quiet prevailing and from the utter absence of coal dust, as where formerly thirty coal stokers were required on each eight hour gang, that is ninety per day of twenty-four hours, and 400 tons of coal were daily consumed, one foreman only per eight hours is required to watch the water gauges.

The foregoing short sketches will have served to show, that, even with these primitive heating arrangements great results could be obtained, that, the manner of using the force inherent to natural gas, was a very crude one, and that with more perfected fire chambers, much less gas would be necessary to obtain the required temperatures. You can form no idea, gentlemen, of the vast quantities of gas which go to waste by burning in the air, or escape otherwise unutilized. It was estimated that in the neighborhood of Pittsburg above 100,000,000 cubic feet of gas were lost daily, without any advantage whatsoever. Now taking 7½ cu. ft. of gas equal to 1 lb. of coal as per fuel value previously given, we have 100,000,000 cu. ft. of gas equal to 6,667 tons of coal, which estimated at $1.25 per ton, would represent more than $8,000 daily loss of capital.

The largest of the existing companies in Pittsburgh is the Philadelphia, which was formed in 1884 and which paid a dividend in the quarter ending June, 1886, of $150,000. This company has 25 miles of 20-inch (cast-iron) main in Pittsburg alone, and a total pipeage there of 525 miles. This company is now supplying 500 industrial establishments with fuel, in which number are included all sorts of factories, hotels, and buildings, and in addition thereto 8,000 dwellings within the city proper, not counting industrial establishments and dwellings in the surrounding villages which are supplied and those of Allegheny City.

To give a correct statement regarding the total number of gas wells and the total length of all the pipe lines and number of gas subscribers would be very difficult, and I will only mention that about 900 miles of pipe line are laid in Pittsburg, and that about 15,000 dwellings in Pittsburg and Allegheny are supplied with natural gas.

It goes without saying, that the question regarding the continuation of the gas flow is one of extraordinary importance; and there is not a reasonable doubt but that at some time an exhaustion of the gas and oil fields will take place. The production of the heaviest known gas wells is estimated at about 25,500,000 cu. ft. daily, and that of other prolific wells at about 12,000,000 cu. ft. daily. Now, supposing even that the period of decomposition of the oldest organic formations, the volatile parts of which we find in natural gas, have accumulated during many millions of years in incomprehensibly vast quantities, the supply, however immense, must eventually become exhausted: and, only the theory of a continuous new formation can uphold the belief in the inexhaustibility of natural gas.

The same circumstance which we have noticed in oil wells, also occurs with gas, inasmuch as many gas wells in the course of time suffer a loss of pressure and lose some of their currents entirely.

The most exaggerated accounts will creep into the newspapers, as was the case last September with the New York papers, which were largely copied by the German press, stating that natural gas in the Canonsburg district had suddenly ceased to flow.

It must not be overlooked, however, that only such wells became exhausted as from their inception only produced small quantities of gas at light pressure; and that frequently in drilling deeper, or in drilling a new hole in the immediate vicinity of such an exhausted well, new gas veins were struck; as also that during the early period of oil discovery, such occurrences were considered as indicating a partial or total exhaustion of the oil springs, whereas at the present time, after a lapse of thirty years, oil is still produced in very large quantities. In the potent gas district of Murrayville, which has the greatest number and oldest gas wells, no decline in the pressure has been verified, and even at the oldest well there, drilled ten years ago, no perceptible decline in the pressure has been noticed. Some wells are known to exist elsewhere, which have produced gas for fifteen to twenty-five years with undiminished pressure. The fact that gas wells will some time stop, and on being drilled deeper, go on with renewed activity, is shown by a well in the Canonsburg district, in the mill-yard of the Canonsburg Iron & Steel Co., and belonging to that company, which in September, 1886, showed a pressure of 300 lbs., and then suddenly subsided to a merely nominal one. This well, on being drilled 12 ft. deeper, developed new gas currents of such force as to show a pressure of 550 lbs. per sq. in., per minute, and is to-day one of the largest gas wells ever discovered in Pennsylvania, the gas rushing out with such force as to continuously coat the pipes with ice.

There is no immediate danger of the exhaustion of natural gas, but the length of its continuation cannot be determined. Supposing the supply of gas to continue undiminished for twenty, or even only ten years, incalculable advantages will have accrued to Pittsburg's industries. Even with the present rates of gas, the saving in fuel alone of 50 per cent., besides the increased out-put, improved quality and economy in the wear and tear of the plant, is very great. A reduction in the price of gas is also looked forward to, as in a few years the entire cost of the gas plants, such as drilling and piping, and interest on the investment, will have been covered.

The irregularity in the pressure, and variability in the composition of natural gas will be more felt, as the improvements in its economic application progress; but the above disadvantages may be in a measure regulated by uniting as many different gas springs as pos-

sible in one and the same pipe line, and thus equalizing the pressure.

Pittsburg and its industrial surroundings, until within a few years, required 30 000 tons of coal daily; in the summer of '86, one-third of the quantity was replaced by natural gas, and in the autumn of the same year, the quantity of coal replaced by natural gas was estimated at 12,000 tons daily, so that according to this, 180,000,000 cu. ft. of gas were daily consumed, taking the fuel value of gas to be 7½ ft. to 1 lb. of coal.

The interesting article by Prof. Dr. BEYER, in the last issue of *Steel and Iron*, gives us a very clear, but alarming picture of the development and extension of American iron and steel industries, and also of the fact that the time is not far distant, when American iron and steel manufacturers will enter into competition to supply the markets of the world. With all due allowance for the results obtained by American iron industries, I nevertheless believe that as regards technical capacity, those of Germany do not lag behind them. The United States undoubtedly leads, as regards mechanical labor-saving appliances, which is most clearly shown by the statement taken from Prof. Dr. BEYER'S article, viz:

"82 tons of steel will be produced by one workman in America, as against 33 tons produced by one here, in a given time, or in other words: forty workmen in the United States will accomplish the same work as 100 here."

We, however, have the advantage over America in the more economic adaptation and management of our plants and machinery, as also in the uniformity of the quality of our product, which suffers somewhat in the United States from an over desire to produce the largest possible quantity. But, supposing these differences, as well as that of technical capacity equalized between both, the United States still retains the advantages of its great mineral wealth. Ores and coal are at their disposal in such vast quantities as to be beyond our comprehension, and new fields are constantly developing; only recently coal, lime and ore have been found together, in close proximity in Southern Virginia, and particularly in Alabama, regarded by many as the future Eldorado of American iron industries. The disadvantage of high wages and high freights on ores under which Pittsburg suffers, are more than equalized by its cheap fuel; and when we consider the important bearing which the iron and steel works of this industrial district have on American iron industries, as our competitors, the question of the influence of natural gas is one of great interest and importance to us.

An Examination of some Recent Experiments on Sewage Treatment made, by Mr. W. J. Dibdin, F.C.S., the Metropolitan Board of Works.*

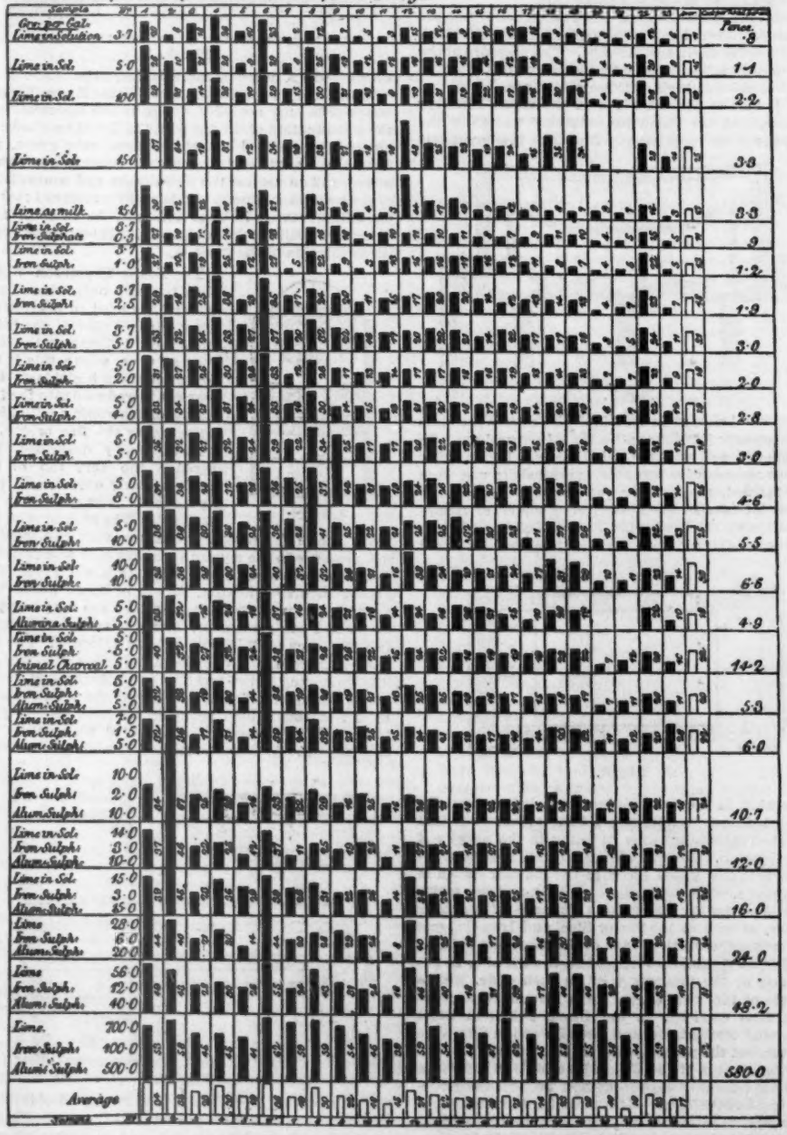
BY E. W. PEREGRINE BIRCH, M. I. C. E., F. G. S.

At the Institution of Civil Engineers at the beginning of the year an admirable paper was read by Mr. DIBDIN, Chemist to the Metropolitan Board of Works, upon "Sewage Sludge and its Disposal," in which he sets forth the process about to be put into operation by the Board for the treatment of the sewage of London. The metropolitan sewage is to be treated with 3.7 grains of lime and 1 grain of sulphate of iron per gallon, and Mr. DIBDIN produced the results of a large number of experiments to show that although greater purification might have been effected by a greater expenditure of chemicals, the improvement would not have been worth its cost.

Great difference of opinion was expressed in the discussion as to the capability of such homœopathic treatment, and it is not proposed here to say anything about the relative merits of different precipitants; but the 500 odd analyses made by Mr. DIBDIN besides showing the relative merits of different agents also show the relative susceptibilities of the sample tested, and it is to call attention to the importance of this difference that the author has ventured on this occasion to address the society. In this communication there is nothing but what could be extracted from Mr. DIBDIN'S paper; but the object in the two cases not being the same, it has been thought worth while to utilize the large mass of well authenticated facts obtained by the Metropolitan Board of Works to teach a lesson which on the former occasion was not emphasized as the present author considers it might have been with great advantage.

Mr. DIBDIN took twenty-three samples of sewage from the Metropolitan Outfall at Crossness, and having extracted from them the matter in suspension, treated each in twenty-five different ways. He used lime alone in quantities varying from 3.7 to 15 grains per gallon, sometimes in solution, sometimes as milk of lime. He used lime in conjunction with sulphate of iron in various proportions, lime together with sulphate of alumina, lime supplemented by both sulphates, and also lime, sulphate of iron and animal charcoal together. As will be seen from the diagram, the chemicals necessary for these treatments were estimated to cost from .81 of a penny per head per annum, to 48 *s.* per head per annum and it is obvious from Mr. DIBDIN'S figures that the use of the larger quantity of chemicals would, independently of the expense of dealing with the increased quantity of sludge, have cost a great deal more than their worth. It is to be learned from Mr. DIBDIN'S figures that whether he added 4.7 grains of chemicals or 108 grains to the gallon at costs respectively of 1¼*d.* per head and 48*s.* per head, it did not make more than 20 per cent. difference in the amount of organic matter removed. This is very strong if not conclusive evidence in support of the opinion arrived at by the Board of Works, namely, that it was best to limit the amount of chemicals used as proposed by Mr. DIBDIN. But although the difference between the effect of one precipitant and another precipitant upon any one of the samples tested is small compared with the cost, the difference in the extent to which two samples have been found to yield the dissolved organic matter contained in them is very striking, and this brings the author to the point he wishes to impress upon the members of this Association having the management of sewage precipitation works, viz., that more is to be expected from experiment and research into the question of what are the influences affecting the susceptibility of sewage to chemical precipitation than from trials of different chemical agents. The diagram shows what percentage of the dissolved organic matter was removed from each sample by every one of the different precipitants. The horizontal rows of ordinates represent the results of one treatment upon twenty-three different samples; the vertical columns the results obtained from treating one sample in twenty-five different ways.

Diagram showing the Percentage Reduction of Oxidizable Organic Matter in Solution by various methods of Chemical Precipitation upon 23 different samples of Sewage.



* Paper read before the Society of Municipal Engineers and Surveyors.

0 per cent. to 29 per cent. and 16 per cent., or an average of 8 per cent. and 9 per cent., showing that where the greatest success attended the treatment the result was due more to the sewage than to the precipitant used.

It will be seen that certain samples have yielded up their impurities far more generously to all of the treatments than other samples have to any, and that certain samples yielded more dissolved organic matter to 15 grains of lime that they did even to a greater quantity of lime together with a considerable addition of sulphate of iron and alumina. Columns Nos. 1, 6, and 22 show that a sample of London sewage may be in such a condition that it will yield its dissolved organic matter practically equally as well to any of the twenty-five treatments. The few weak places in columns No. 2 and No. 4, and the one weak place in No. 22, suggest that their occasional stubbornness is due rather to the temporary condition of the sewage when treated than to the class or quantity of filth which they contained, and that the inefficiency of all the reagents alike to touch samples 20 and 21 may be due rather to the conditions under which they were treated than to the elements of which they were composed.

It is obvious when certain samples of sewage yield generously to twenty out of twenty-five different treatments, but in the other cases resist reagents which have been effective with other samples of the same sewage, that the strength of sewage is not the only factor to be considered, and that the variety of result must be due to some varying physical condition, possibly age or temperature, or degree of decomposition of the sewage when treated, or perhaps to the temperature of the atmosphere or the barometric, or photological conditions prevailing at the time.

The author knows that Mr. DIBDIN has not at present satisfied himself as to the meaning of the facts collated on the diagram further than was necessary for the question he had in hand at the time he made the experiments; but the author believes that if the science of sewage precipitation is to be advanced, it must be through investigations, by gentlemen in this Association, of the nature and extent of the outside influences which affect the action of precipitating agents upon sewage.

The Paris 1000 ft. Tower.

The accompanying illustration is *not* a view of a wreck, as would appear, but represents the base of one of the main piers of the 1000 ft. tower now being erected upon the Champs de Mars, in Paris, as reproduced from a late number of *Le Genie Civil*.

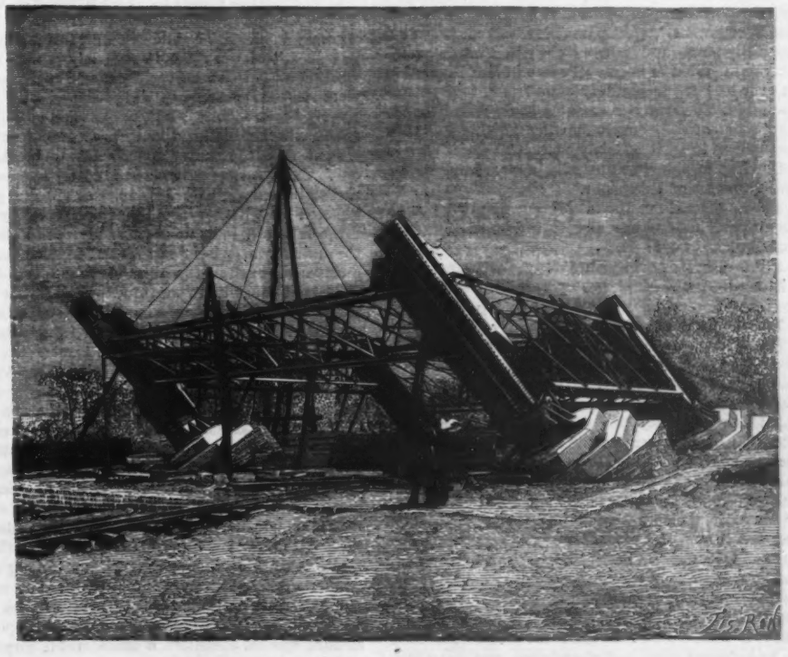
We have already described the difficulties overcome in securing a firm foundation for this towering structure, in the wet and variegated strata underlying the site. They were finished during last June, and the erection of the metal work was at once commenced and it is now about 50 ft. above the surface of the ground.

The inclination of these piers is 54°. Each corner-post is fixed to mass of masonry by a shoe of cast-iron connected with a steel anchoring pin (*tampon*) weighing 5500 lbs. and in each shoe is fixed a hydraulic screw of a capacity of 800 tons and weighing 15,400 lbs. These screws enable the erectors to re-establish absolute equilibrium in the structure in case of any accidental deviation. While this deviation is little feared, on account of the exactness of previous calculation and actual tests, yet when the great flare of the piers and the necessity for the mathematical convergence of the elements of this mass are considered, the importance will be recognized of having means to take up or eliminate any error even infinitely small in the beginning. To this end every member of the structure as it leaves the shops of M. EIFFEL, at Levallois Perret, is very exact in all its dimensions, cut and punched in such manner as to leave no work of this kind to be done on the ground.

The mounting will be done in three stages, the first already going on, and the other two thoroughly studied out. The first covers the mounting of the inclined main posts upon their shoes. These are being raised by means of struts and ties riveted to each other and to the pier members in such manner that no exterior support will be required up to a height of about 85 ft. Above that point the vertical of the center of gravity of the mass falls outside the base and a timber falsework tower will then be built inside each inclined tower to support it.

The distribution of the post members upon the piers and their erection offer special difficulties as the height increases above the present figure, that is 50 ft. This difficulty will be overcome as follows:—The interior angles of the tower corner-posts offer a plane surface, and lifts will be arranged to run on them in such manner as to carry four cranes or derricks, each with a sweep of 40 ft. and a lifting power of a little over 3 tons. These derrick supports will be temporarily bolted to the corner-posts and lifted in stages of about 13 ft. following up the erection.

At the height of 141 ft. the four great inclined trapezoids will be connected by four horizontal latticed trusses, each 22.96 ft. in depth and 137.76 ft. span, forming the first stage of the great tower.



One of the Base Piers of the 1000 ft. Tower.

Timber falseworks will be used in erecting these trusses. With these trusses in place and secured, the work of erecting the tower proper will begin at a height of 164 ft. above the ground. The constructors seem to have abandoned the idea of using the arches (shown on the original plans) as a means of transmitting load or securing rigidity; they will now be merely decorative features in softening down the angles of the structure.

It is expected that by the end of this year the tower will have reached the 164 ft. mark, and 3000 tons of iron will then be in place. M. EIFFEL expects the entire tower to be finished by October or November of 1888, and with this in view he is pushing the architectural, or decorative features along with the construction proper. The architect is M. SAUVESTRE, an artist and man of acknowledged talent. As far as erected, the simplicity of the work and the absence of any apparent striving after effect not due to pure construction are the striking features of M. EIFFEL's design.

The Institution of Civil Engineers, and Subjects for Papers.

The Council of the Institution of Civil Engineers, for the session of 1886-87, have awarded to its members, 4 Telford medals and 16 Telford premiums, 2 Watt medals and 1 Manby premium. The Students of the Institution received 1 Miller scholarship and 6 Miller premiums. The Institution also publishes a list of 49 subjects upon which they invite original papers either from members of the Institution or from strangers. This list is very suggestive, and we give it as follows:

1. The utilization of unused sources of power in nature, such as the tides, the radiant heat of the sun, etc.
2. Tacheometry, or rapid surveying.
3. The distinguishing qualities of clay to make good puddle.
4. Colonial woods suitable for engineering purposes.
5. The influence of sea-water upon Portland cement mortar and concrete.
6. The wind-pressure upon structures, as influenced by (1) their superficial area; (2) the form or position of the exposed surfaces: (3) the shelter of adjacent bodies; and (4) the dynamic action of sudden gusts upon elastic structures.
7. The working strength of iron and steel as affected by (1) the amplitude; (2) the frequency; and (3) the time-rate of the stress variations.
8. Description of any new or peculiar form of mountain railways for very steep gradients.
9. Recent irrigation works in California.
10. Machinery and arrangements for distilling water by multiple effect.
11. The effect of different qualities of water on the condition and duration of cast-iron pipes.
12. On the sale of water by measure.
13. Uniformity in system (international) of coast lighting by lighthouses, light vessels, and their auxiliaries, automatic lighted beacons and buoys.
14. Recent improvements in cable tramways.
15. The present position of the manufacture of steel—its defects and suggestions for its improvement.
16. The action upon basic steel of (1) chromium, (2) aluminium, and (3) tungsten.
17. The use and testing of open-hearth steel for boiler making.
18. The production of aluminium and its alloys, with their properties and uses.
19. Manganese in its application to metallurgy.
20. Improvements in zinc smelting.
21. The application of steel castings and of steel forgings to the construction of ordnance and projectiles.
22. Rapid-firing guns.
23. On forging by hydraulic pressure.
24. The most recent types of (1) mail steamers; (2) cargo steamers; and (3) war-ships.
25. On the use of liquid fuel for steam-boilers and other industrial purposes.
26. The independent testing of different types of steam-engines, including triple expansion and quadruple-expansion engines.
27. The construction of the working parts of steam-engines, in relation to the high pressures and temperatures now becoming general.
28. The practical limit to the working-pressure of steam in marine boilers.
29. Auxiliary engines connected with the modern marine engine.
30. On speed indicators for locomotives.
31. The construction and efficiency of steam-turbines.
32. The transmission of steam underground in the United States, with the results obtained.
33. Hydraulic pumps for working at high pressures.
34. The relative economy of various modes of distributing power over large areas.
35. Descriptions of hydraulic rams and of turbines, with actual quantitative results.
36. The means of governing and economizing high-pressure fluid in hydraulic cranes, engines, etc.
37. Tools used in the building of iron and steel ships, and in the construction of boilers.
38. Type-composing and distributing machines.
39. On natural gas, and its application to the industrial arts.
40. Compressed oil-gas, and its applications.
41. On the spontaneous combustion of coal in ships.
42. Appliances for the rapid shipment of coals, with a comparison of different methods.
43. Electro-motors; their theory, construction, efficiency, and power.
44. The construction and maintenance of secondary batteries.
45. The distribution of electricity for the lighting of towns.
46. The application of electricity to the working of street tramways.
47. The application of electricity to smelting and metallurgical operations.
48. Means of insuring the safety of blasts in explosive atmospheres.
49. Contributions to the bibliography of special branches of engineering.

The American Line from Vera Cruz to the City of Mexico, via Jalapa.

WITH NOTES ON THE BEST METHODS OF SURMOUNTING HIGH ELEVATIONS BY RAIL.

[A paper by A. M. WELLINGTON, M. AM. SOC. C. E. read before the American Society of Civil Engineers.]

(*Continued from page* 183.)

In view of what has preceded, the writer hopes that he may not be suspected of over-estimating the difficulties of securing such lines, or of personal inability to cope with them, when he declares his conviction that this whole method of taking railway lines up difficult ascents by a continuous succession of curves and tangents on a rising grade, over which the locomotive keeps up a steady march, is fundamentally wrong and bad, and one which might profitably be modified in nearly all cases when an elevation of over 1000 ft., or possibly much less, is to be surmounted. To furnish a suitable background for the expression of these conclusions, by showing that they are formed in spite of fairly successful experience in following up the more usually approved plan, is a main purpose of this paper.

Three general methods for surmounting such elevations, besides the almost universal one, are more or less in use:

First.—Rack or grip railways.

Second.—Inclined planes operated by stationary engines.

Third.—Switch-backs.

The first of these was proposed in a practicable form over thirty years ago, and the two latter antedate the locomotive itself. Either one of them is probably deserving of more use than is given it, but the third (switch-back) the writer seems worthy of adoption by engineers as the standard plan for surmounting considerable elevations, always provided the switch-backs be constructed and operated in quite a different manner from that usual in the few which exist, which have for the most part only been resorted to as a last resource.

One feels a natural hesitation in expressing a conclusion which, it must be admitted at once, all the tendency of modern practice tends to discredit. The accumulated verdict of experience is rarely wrong, and it is undeniable that all these plans have been in many cases tried and abandoned, and have met decreasing favor. Nevertheless, causes needless to go into, other than lack of real merit, may explain in part at least this result, and the writer sees no escape from believing that they do so wholly.

The various forms of rack or grip railways have never yet won marked success for other than scenic lines of light traffic, where economy of operation was no great object. The most promising effort in this direction, by far, is the Abt system, recently described by Mr. W. W. EVANS, M. Am. Soc. C. E., in a paper before this Society, which certainly has features of striking merit which will lead engineers to watch its progress with great interest. Among these are the rack with stepped or staggered teeth: the compound gear-wheel engaging therewith, with its peculiar elastic adjustability, insuring even bearing of the cogs on the rack at all times, and, above all, the admirably ingenious footing to the rack, by which a locomotive working by ordinary traction may approach the foot of the rack grade at ordinary working speed, retaining all its momentum, and leaving the adhesive traction cylinders still working, with certainty that the rack gear will engage smoothly and without shock, and work conjointly with adhesive traction thereafter, thus removing the most serious theoretical objection to the locomotive, that it is unable, except within a very limited range, to increase the tractive force exerted by it at the expense of speed. But with all these merits the apparatus is rather costly, both for maintenance and renewal, and its range for profitable employment must be limited.

The capabilities of the inclined plane or cable plan have been greatly extended in recent years, as applied to street and local passenger service, and it is clearly destined in the near future to still wider use. Superficially, the record of its use in connection with ordinary railways is most discouraging to any hope of its future usefulness in that direction. In the early days of railways it was constantly considered, and often used. A complete plant of the kind existed over the Allegheny summit of the Pennsylvania Railroad before that line was built, and was abadoned in favor of locomotive traction, even to connect two lines of canals. Several complete railways operated by successive inclined planes and gravity inclines were built in Pennsylvania and elsewhere—two in Northern Pennsylvania of considerable length, one of which is still in use and the other only recently abandoned, but not chiefly, if at all, for reasons affecting its abstract merit. It is not generally known that the existing main line of the Pennsylvania Railroad over the Allegenies, which was built long after the old planes had been abandoned, was laid out with the distinct view of afterwards adding a new and enlarged system of planes for freight traffic when the volume of traffic had increased to justify it. This policy was favored by its distinguished chief engineer, Mr. J. EDGAR THOMPSON, and some elaborate and interesting data in respect to it are given in the early reports of that road, notably in a report by the then Superintendent, Gen. HERMAN HAUPT, in which the ground is distinctly taken that it is a mere question of volume of traffic whether inclined planes are economical or not.

That view the writer apprehends to be the true one. The fixed tractive plant is costly to construct, maintain and operate, and expenses are not greatly affected by whether the tonnage moved by it be large or small. It by no means follows that, because the system was wisely abandoned in favor of locomotive power, for the thin traffic of those early days, that it is wise to continue to neglect it at points where almost a steady stream of laden cars is to be carried, first up and then down a dividing ridge, day and night, the year round, as on the Pennsylvania summit, and at many similar localities. At such points it is demonstrable that not only may the great amount of power used in lifting locomotives be saved, but that the descending and ascending cars may be balanced against each other, thus largely eliminating the effect of the rise; while the superior economy of stationary engines will largely reduce the cost per horse-power, after allowing for the friction of cables, which, on a short, steep incline is a minor element. Especially now that the making of long continuous cables is so well understood, so that as long an incline as the topography permits may be readily worked, it is worthy of the most serious study whether a very large economy is not readily possible at such special localities, a considerable number of which may be counted up.

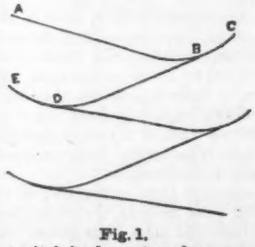


Fig. 1.

A proper switch-back system, however, seems to the writer the most generally useful and meritorious for lines of probably thin traffic, as well as the most unquestionably practicable for use in all such localities. The germ of the proper system was contained in the first switch-back laid out in America, if not in the world—that at Mauch Chunk—which was used for dropping empty coal cars down into the Nesquehoning Valley, before the tunnel of that name was completed. That track was used only for cars passing in one direction (descending), and was operated as follows:

The cars were started from *A*, Fig. 1, on a down grade of about 1 per cent., calculated to give a considerable velocity. At *B* an automatic switch, whose exact mechanism the writer cannot give, was run through and the car brought to a rest by the next succeeding up grade at *C*, from which it immediately started back towards *D*, passing through the switches *B* and *D* until again stopped at *E*; and so on indefinitely, the cars descended several hundred feet in all without the slightest attention, very rapidly, with very rare accidents, and with no one on them or stationed along the track.

Thus, to say the least, every advantage was gained that could have been gained by a long continuous descent, with the immense advantage that, owing to the entire liberty of choice as to the length given to each plane, the best alignment and lightest work available on any part of the surrounding country may be chosen.

But more than this was gained. Any long continuous grade which is steep enough to move cars with journals in rather bad order, must be steep enough to speedily give cars in good order a dangerous velocity. Thus, it would be impossible to let cars run of themselves down a continuous grade of any kind, while, on the switch-back, not only was this very readily done, but a pretty high average velocity could be safely used, from the fact that it in any case could not exceed a certain maximum. Again, when necessity required, it was easy to stop cars at any point.

Analogous advantages are readily obtainable, *mutatis mutandis*, by switch-backs operated by regular trains running in both directions, but not under the conditions of ordinary practice, which necessitates the complete loss of all the *vis viva* of the train at every switch. The plan shown in Figs. 2 and 3 will apparently obviate this necessity completely, and introduce no new elements liable to cause difficulty, but, on the contrary, give smooth, easy and rapid motion. The details of this plan are as follows:

AS RESPECTS THE SWITCHES.—The switches should be, and are easily made, entirely automatic. Their normal position should be that in Fig. 2, in position for running up and not down hill. A runaway train or car cannot then pass a switch and continue down grade. As respects a train going up grade, this arrangement presents no difficulty. It may simply run through the switch *D*, springing the points over to let the wheels pass. Simple devices of many different forms may be used to restrain too rapid return of the points after the passage of each single wheel, but this is not essential, as the wear and tear would be small.

A train descending should be able to operate the switch, so as to continue descent by a single act of the engineer, but only by intention on his part. This may be accomplished by a very simple and inexpensive apparatus, such as that outlined in Fig. 2, operated by a lever or idler wheel on the locomotive controlled by the engine-man, and with mechanism somewhat similar to that of the simpler forms of interlocking apparatus, which it would be superfluous to describe in detail, as it can be designed in a few hours by any signal engineer. The general method of operation is described below Fig. 2, the whole insuring that (1) up trains shall always pass the switches freely and automatically; (2), that runaway down trains shall never pass them, but be caught; (3), that regular down trains shall be enabled to pass the switches automatically by a single act of the engineer; (4), that careless neglect of this act shall do no other harm than to cause the train to run back again on the up track; (5), that danger signals shall be set when the switches are wrong, or any part of the apparatus broken; (6), that the switches can at all times be operated by hand if desired, or if mechanism is out of order.

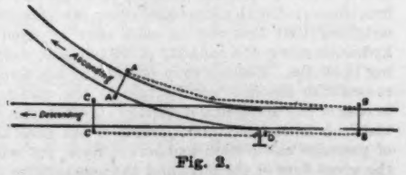


Fig. 2.

The mechanism here outlined acts as follows:

DOWN TRAINS.—A place B and C in position to act, which are otherwise entirely inoperative.

B, when first made operative by A, opens the switch D for track C, and holds it open.

C, always operative when B is, returns A, B, and D to their original positions.

A, B and C are supposed to be located with reference to having the engine always at the same end of the train. If the engine be at the other end the switches must be operated by hand.

UP TRAINS.—If, by careless neglect, the engineer of an up train should leave the switch-actuating lever down, nothing will happen except to set A as if for a down train, in leaving the switch track. This will not effect following trains either down or up. Should a succeeding up train be equally careless it will act first on C and then on A, thus running through the switch with no effect.

AS RESPECTS THE ADJUSTMENT OF THE GRADES.—Fig. 3 shows in detail what the writer regards as the proper adjustment of grades for a 2 per cent. switch-back, and the principle of the adjustment for any grade. With this arrangement it is unnecessary for an up train to use brakes, or even shut-off steam at all, for making the stop and then starting backwards.

It will be seen that the up grade continues unbroken until it has passed the switch, and then rises in a sharp vertical curve, which rises above the regular grade, slowly at first, and at the further end—merely as a precaution against accidents—rises very rapidly indeed. This is to bring the train to a stop slowly and gradually, but certainly, without either shutting off steam or using brakes. The rise necessary to do this for any given train speed may be computed exactly, and is given in the following Table No. 3, computed by the writer and not elsewhere readily accessible.*

lever, at the moment the train comes to a stop, from full gear forward to full gear back.

With ordinarily careful and safe working, the speed at *T*, Fig. 3, would be about 10 miles per hour higher than the speed of approach, a gain far more than sufficient to obviate all loss of time from the stop, and equivalent (for speeds of 10 miles per hour approaching and 10 miles leaving) to a subtraction of 10.65 vertical ft. from the rise in the next grade—a gain which will considerably increase the average speed of hauling capacity, or both.*

Fig. 3 equally well represents the conditions at

TABLE No. 3.

Giving the Total Energy of Potential Lift in Vertical Feet in Trains Moving at Various Velocities.—Including the Effect of the Rotative Energy of the Wheels or Passenger or Loaded Freight Trains, assumed at 6.14 per cent. of the total energy. For trains of empty flat or coal cars add about 4 per cent. to the quantities below, and proportionately for mixed trains.

MILES PER HOUR.	0.	Diff.	1.	Diff.	2.	Diff.	3.	Diff.	4.	Diff.	5.	Diff.	6.	Diff.	7.	Diff.	8.	Diff.	9.	Diff.	
0.....	0·00	·04	0·04	·10	0·14	·18	0·32	·25	0·57	·32	0·89	·39	1·28	·46	1·74	·53	2·27	·61	2·88	·67	0
10.....	3·55	·75	4·30	·81	5·11	·89	6·00	·96	6·96	1·03	7·99	1·10	9·09	1·17	10·26	1·25	11·50	1·32	12·82	1·38	10
20.....	14·20	1·47	15·67	1·52	17·19	1·60	18·79	1·67	20·46	1·74	22·20	1·80	24·00	1·88	25·88	1·95	27·83	2·03	29·86	2·09	20
30.....	31·95	2·17	34·12	2·23	36·35	2·31	38·66	2·38	41·04	2·45	43·49	2·52	46·01	2·59	48·60	2·66	51·26	2·74	54·00	2·80	30
40.....	56·80	2·88	59·68	2·94	62·62	3·02	65·64	3·09	68·73	3·16	71·89	3·23	75·12	3·30	78·42	3·37	81·79	3·45	85·24	3·51	40
50.....	88·75	3·59	92·34	3·65	95·99	3·73	99·72	3·80	103·52	3·87	107·39	3·94	111·33	4·01	115·34	4·08	119·42	4·16	123·58	4·22	50
60.....	127·80	4·30	132·10	4·36	136·46	4·44	140·90	4·51	145·41	4·58	149·99	4·65	154·64	4·72	159·36	4·79	164·15	4·87	169·02	4·93	60
70.....	173·95	5·01	178·96	2·07	184·03	5·15	189·18	5·22	194·40	5·29	199·69	5·36	205·05	5·43	210·48	5·5	215·98	5·58	221·56	5·64	70

Formula: Vel. head $= \frac{v^2 \text{ in ft. per sec.}}{64.32} = \frac{1.467^2\ V^2 \text{ (in miles per hour)}}{64.32} = 0.033445\ V^2$

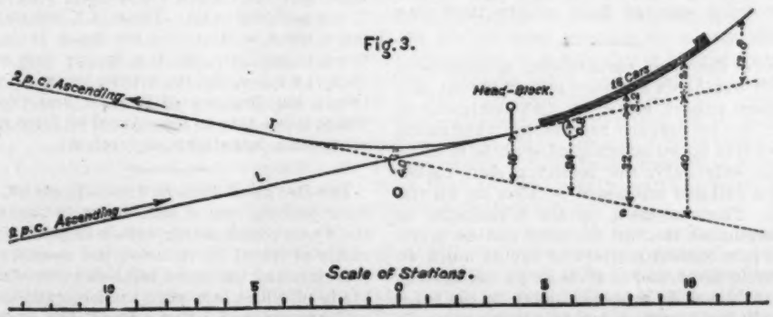
To which add 6.14 per cent. for rotative energy of the wheels $= 0.002055\ V^2$

Giving as the final formula, by which the table is computed. *Vel. head* $= 0.035500\ V^2$

Suppose a train to be ascending the 2 per cent. grade at a uniform speed of 15 miles per hour. Then, by the table, a lift of 7.99 ft. above the regular grade will bring it to a stop even with the engine still using steam. If the velocity be only 10 miles per hour, a lift of 3.55 ft. only will be necessary, and this will or can readily be made to be the usual speed of approach. In that case, if the train consist of 10 cars and be 400 ft. long, it will come to rest with the steam still on, unchanged, when the rear of the train has passed a little over 100 ft. past the switch, the center of gravity of the train being then 3.55 ft. above the tangent grade line. The slack of the train will be taken out, under these conditions, very gradually indeed, and almost at the instant of coming to rest.

If, then, without changing the throttle, the reverse lever be thrown over into back gear, or even merely into mid-gear, so as to do no work at all, the train will immediately start backward, still holding all the slack out of the train, which will continue out until forward motion is resumed at the next switch-back. If the lever were immediately placed in the same notch of back gear in which it formerly stood in forward gear (which would be unnecessary) the speed which the train would have acquired on resuming the upper straight grade at *T*, Fig. 3, would be that due to the height *c*, which is $3.55 + (8 \times 4) = 35.55$ ft.; or, as per Table No. 3, 31½ miles per hour, an objectionably high, but not dangerous, speed. Had the velocity of approach from below been 15 miles, this speed would have been that due to 37.99 ft., or only 32¾ miles per hour, and had the velocity of approach (in case of passenger trains) been even 20 or 25 miles, this speed would have been only 36 or 39 miles per hour. Thus the switch, with grades arranged as shown, can be run through at any speed, making no more change in the brakes, steam or engine, than to throw over the reverse

Fig. 3.



the next ensuing switch-back, where the train approaches rear-end to it, if we simply assume the engine to be at the other end of the train. It reaches the position shown, backing up from below, with all slack out of the train. In starting forward on the up grade, the rear end of the train, being on a steeper grade than the engine, will tend to crowd slightly upon it, and by setting the reverse lever in the second or third notch of forward gear, the slack will be taken out in the gentlest possible way, far more gently than is ever possible in starting on a level.

Thus the ordinary and great objections to sharp hollows in grade lines do not apply in this case. On the contrary, the action is smoother than it would be without the curved profile. Similarly, the still greater objections to a stop on the grade line do not apply at all in this case. We rather gain by it, because the whole train stops and starts again with the gentleness and economy of energy of a pendulum, for identical mechanical reasons.

This being so—there being no loss of time, no loss of distance, no loss of hauling capacity, and no measurable loss in smoothness of motion—we have left as a net gain two things: *First*—A great additional safeguard against collisions with and derailments of runaway trains or parts of trains. Accidents resembling the terrible one on the Southern Pacific, on the Tehachapi grade, some years ago, in which nearly all of a train-load of people were killed or injured, are not likely to occur. Before a train can attain a velocity of 60 or 70 miles per hour, it must fall 128 or 174 ft. in excess of the fall required to overcome its resistance. If we estimate its average resistance in acquiring that speed at 20 lbs. per ton, equivalent to the acceleration on a 1 per cent. grade, a train must descend a 2 per cent. grade for 2½ to 3¼ miles before it will acquire those velocities. A single car would take much longer yet, so that a switch-back every 3 or 4 miles would go far to insure against the worst results from such catastrophes, which no care can wholly avoid.

Second.—A great reduction in cost of construction and amount of curvature, and usually in rate of gradient as well, is assured; in some cases more than others, but always considerable. In the line described in this paper, the writer estimates that half the curvature, and nearly half the cost of construction to subgrade, might have been saved by using not more than eight or ten switch-backs on the whole ascent of 8,000 ft., through the better choice of ground afforded. An entirely different route would have been selected, and nearly the whole line might have been reduced to but little more than a surface line.

On the other hand, there is the unquestionable disadvantage in switch-backs, that engines do not pass curves well running backward. In part this is remediable in the design of engines, and by leaving the rear drivers blind, but the only proper course would be to use an easier maximum curve on the sections on which the engine runs backward, which would be the same both ascending and descending, and to make those sections as short as possible.

Thus, the writer believes, this objection, while it cannot be entirely removed, may be reduced to very small dimensions; and should it again fall to his lot to locate a line of railway upon an ascent of 8,000 vertical feet, or even a half or a quarter—or, possibly, even an eighth—of that amount, he will in no case willingly attempt to locate it for an unbroken locomotive run, but either use switch-backs for a light traffic, or study with great care the possibilities of the locality for inclined planes with a heavy traffic.

BRIEFLY stated, the history of the Baltimore and Ohio Railroad would read as follows:—It was first suggested by PHILIP E. THOMAS in 1826; in 1827 it was chartered by the Maryland Legislature, being the first chartered and fully organized railroad company in the United States. In 1828 the State subscribed $500,000 towards the enterprise, and on July 4, of this year, the first sod was turned. The first division of 13 miles to Ellicott's Mills was opened to traffic May 22, 1830, horses and mules being the main motive power. But in Aug., 1830, PETER COOPER'S locomotive was placed on the track, hauling 20 passengers at the rate of 5 miles per hour. In 1842 the road had reached Cumberland, 178 miles from Baltimore, and was extended to Wheeling in Dec., 1852. The first train crossed the Alleghenies and reached the Ohio river Jan. 1, 1853. The road between Baltimore and Wheeling cost $15,000,000. Up to 1857 the road had never been profitable, but in this year JOHN W. GARRETT, a Baltimore banker, was made its President and died in office in Sept., 1884. GARRETT, having a large private fortune, limited his salary to $4,000 per year, and so kept down all other salaries, and, under his regime, the stock rose in value from 50 to 200. The capital stock is 150,000 shares of $100 each. The present large holders are: The GARRETT family, 45,000; City of Baltimore, 32,500; Johns Hopkins University, 17,000; GREGG Bros., 6,000; W. F. BURNS, 4,000, and A. S. ABELL, 1,000 shares.

Messrs. FAURE and KESSLER, as the result of late experiments in the preservation of lime stone, recommend the use of metallic fluosilicates, more especially those of aluminum, magnesium or zinc. The surfaces to be treated should be brushed over with the solution and cause an abundant froth due to the liberation of carbonic acid gas. When dry the application is repeated once or twice according to the character of the stone. For soft stone, 1.7 lbs. of solution at 40° Beaumé are required per cubic yard. The process is completed in 24 hours and the stone can be polished or colored by material put in the solution. It is cheap and can be applied to all cements and mortars containing lime as well as to stone. The theory of the process is that a double decomposition occurs, forming in the first place, silica, calcium and aluminum flourides and carbonic acid gas. Secondly, a reaction takes place between the limestone and the aluminum flourides, producing alumina, calcium flourides and carbonic acid. In this manner each grain of the limestone is covered with an insoluable coat.

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* The table is abbreviated from the revised edition of the author's treatise on "The Economic Theory of the Location of Railways."

* If the train were running up a straight grade L O T at 15 miles per hour (say 22 ft. per sec.) in $\frac{400}{21} = 18.2$ seconds.

Via the switch-back it takes:

O to stop, 800 ft. at average speed of about $\frac{0+22}{3} = 42.5$ seconds.

Stop to T, 1,700 ft. at average speed of about $\frac{0+37}{3} = 43.3$ seconds.

91.8

Loss of time, as nearly as may be, 1¼ minutes.

The train is then moving 10 miles per hour faster, so that it will save this lost time almost within the next mile.

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THE memory of OLIVER EVANS should ever be dear to American engineers, and we are sure they will read the sketch below of his life and of certain little remembered facts in it with interest. Considering the poverty, thin population, political troubles and wretched mechanical facilities of this country in "1 00 and little or nothing," the part taken by it in the development of the steam engine and the locomotive may fairly be said to be the most honorable page in its engineering history, and leaves no reasonable doubt that had these relative disadvantages been less extreme, this country rather than England would have taken the leading part in the development of the steam engine and locomotive, as it undoubtedly did in the development of the steamboat and electric telegraph, although the record of both countries would no doubt have remained highly honorable to them, as they are now. It is an invidious and hopeless task to distribute credit justly in such matters, but there can be no doubt that EVANS and not TREVITHICK was the original inventor of the high-pressure engine and the first suggestor, in a practical and definite sense, of the steam locomotive, and there is every probability that TREVITHICK derived considerable aid in designing his 1804 locomotive from the plans and suggestions of EVANS, which had been previously sent to England, as he unquestionably did the suggestion of the high-pressure principle. But EVANS and TREVITHICK both were mechanical geniuses of the first grade, both far ahead of their times, and both cut off by that fact from the practical encouragement which might have placed their name by the side of WATTS in achievements as well as in genius. Fortunately there is no room for dispute as to WATTS' pre-eminence in the development of the steam-engine, but it is no disparagement to him to likewise remember that he had the advantage of an immense and immediate demand to encourage and support him, which neither EVANS nor TREVITHICK had.

THE "Fine Specimen of Track" described elsewhere is no doubt rather unusually worth description, but very similar track is to be found even on "first-class roads" much oftener than is generally suspected by those who do not walk over track much. The worst feature of it is the careless spiking, but the least excusable one, perhaps, is the use of shims, which should be positively prohibited on every road except in winter. The shim is a practical necessity in our severe winters to remedy the unequal heaving of the frost, but the frost once out of the ground there can be no possible excuse for continuing its use through the summer. Both the name and the thing is unknown to English and Continental practice, and both have been thoughtlessly made the subject of occasional ridicule, but this is merely because heaving by frost is unknown there. Very much of our heaving, too, is due simply to needlessly bad drainage, and can be remedied in a much better way than by shims, but after all has been done that can be done in that way there must ever remain need for shims where the winters are severe. In summer, and as a regular resort, it is a very different matter.

FROM all parts of the country come "wars and rumors of wars" in freight and passenger tariffs. Even the passenger rates over the trunk lines from Chicago east, which have been so long steady, have broken under the strain of the Philadelphia Constitutional Centennial. This rent is now reported mended, as is also the cut on rates from Chicago, southwest, but judicious observers are none too sure of the strength of the patches.

THE United Labor party seems to have a very vague idea of the duties of a State Engineer and Surveyor for New York, at least, if we can judge by its actions in selecting a candidate for this office. After the nomination was declined by Mr. SYLVANUS H. SWEET, it was tendered to Mr. FRANK FERROLL, a colored "engineer" who attends to the well being of the elevators and dynamos of the Florence apartment house in this city. Mr. FERROLL also declined as he "could not afford it," and now the party has gone outside of its lines and has selected Mr. MATTHEW K. COUSENS, of Yonkers, who is said to be a civil engineer. But as the nomination is likely to be little more than a very empty honor, professional experience is of little consequence, and the engineer of some other apartment house might just as well have been selected from within their own ranks.

ONE of the most embarassing situations in which engineers are ever placed is that of a retained expert, either to give testimony in court or to prepare reports for publication which it is hoped or intended shall be in favor of one side only, the retaining side, rather than a full and unbiassed opinion on all the facts. There seems a certain plausibility in the argument that an engineer has as much right in technical matters to say as much as he can in favor, and as little as he can against a client's case as a lawyer has to do the same thing in legal matters, and this is in a measure admitted and acted upon in the case of engineers permanently retained on salaries, although it is not at all admitted in the case of engineers retained as experts in a consulting capacity. Even in that case the temptation to

> "Be to its faults a little blind,
> Be to its virtues ever kind"

in respect to a client's case is a natural and human one, and in reasonable moderation only the "unco' guid" will be disposed to condemn it very severely.

Nevertheless, it is within certain narrow limits only that this is true. A certain leaning toward a client's case, giving him the benefit of a doubt, may be, and is, pardoned, but it is not permitted to engineers making professional reports over their own names to make biassed or partial statements of scientific facts which have the plain effect to deceive and mislead, and which are apparently intended for that purpose, without serious injury to their professional reputation either for honesty or competency. Doubtless such wrong-doing may occasionally occur from mere inadvertence, especially in adopting and giving forth as one's own the reports of subordinates. But the consulting engineer has no right to be inadvertent in matters of evident moment, and as the mission and excuse for being of such a journal as this is to advance the profession of engineering and prevent the spread of false doctrine in every way, he has no right to complain if inadvertence, which amounts to deception, is commented on as such.

WE have been led to these remarks by the facts in relation to a report on some locomotive tests which are given elsewhere, and which constitute a very bad case of complete misrepresentation—a misrepresentation which is the less excusable because the dynamometric record chosen for comparison was unquestionably an exceptional bit of an exceptional run, when plenty of material which was not exceptional existed to make a fair comparison, and because such an unfair comparison is particularly liable to deceive in this case. The men who have any practical knowledge of dynamometric diagrams and hence can detect the fallacy of such a comparison as that we object to, are necessarily few in this or any other country. There are not a hundredth part as many as there are of those who can correctly interpret ordinary indicator work—and they are not so very numerous. Therefore, there was the more temptation but the less excuse for engineers who *did* understand them, from practical work with them, to present true extracts in such a way as to give the utterly false impression that they gave a fair idea of the comparative working of an ordinary CONSOLIDATION and the Strong locomotive. In publications by patentees and manufacturers we expect such things. In professional opinions by experts of established reputation we do not expect them, nor should they be lightly passed by.

We say all this without prejudice to the real merits of the Strong locomotive, with which it has nothing to do. There is a natural tendency when we find that too much is claimed to grant too little, but that is only less unfair than the other, and the Strong locomotive certainly has features of interest and promise which it is a pity to see injured by false representations, intentional or careless.

THE last great theatre fire in England, with its appalling loss of life, ought to suggest to the whole public a comparison between the security of travel by rail, and the money spent therefor, and the more fatal dangers of many kinds of which are permitted to exist in our midst unchecked, when a much less expenditure than is demanded of railways would suffice to eliminate them. There have been many of these theatre fires, and they are almost always distressingly fatal, one of the worst on record having been the Brooklyn fire, some nine or ten years ago, in which over 300 persons lost their lives. In that and all other such buildings a very moderate increase in first cost would have avoided the danger altogether, and the annual expense of such safety is little more than the extra interest charge on the building, with perhaps some slight loss of seating capacity. The same is true as respects strong structures on railways, yet the great majority of the safe guards which are demanded and secured of them demand a vastly larger expenditure per probable life saved than to make theatres safe.

Yet every one of our cities has theatres in it which are excessively dangerous in case of fire, and still more which are so in what is almost as bad, a panic. But the public neglects to enforce the simple remedies which it can both understand and directly insist on, and does nothing but rail at corporations which take vastly more pains to secure safety than they do.

The New Method of Dimensioning.

As quite a long series of communications by various authors have appeared in our columns under the above somewhat vague title, it may not be out of place to briefly summarize what is meant by it. By the "new method of dimensioning" is meant that the sectional areas of the members of a bridge or other framed metallic structure are to be determined by means of formulæ based upon the results of certain experiments carried out by the Prussian Engineer WÖHLER for his government some years ago. It has long been recognized that a live load acted more destructively than a dead load, and WÖHLER's experiments to some extent showed this. At the same time a live load is not *per se* any more potent than a dead load when viewed apart from certain causes and conditions which serve to render it so. A load of one ton resting upon a beam will cause a deflection of one unit. The same load held so as to just touch the beam and then suddenly released will cause a deflection of two units, but as the vibrations due to this sudden application die away, the final remaining deflection will be but one unit. Here then, on HOOKE's principle of *ut tensio sic vis*, we conclude that the suddenly applied load has produced exactly double the strain on the material of the beam that was produced by the same load quietly and gradually imposed, and hence we say that in calculating bridge stresses it is necessary to add certain allowances for impact.

Now, WÖHLER's experiments were in no sense designed to determine the impactive effects of live load. They went deeper than this, and showed that inanimate fiber had properties the reverse of living tissue, and that while it rests a muscle to relieve it of load, the reverse is the case with iron or steel and probably with every other material of construction, unless leather may be a partial exception, as seems probable. The suddenly applied load produces double its static deflection, not because of the rapidity of its application but because the beam gives way under the load, and the load falling under the action of gravity accumulates energy which can only be resisted by a further deflection of the beam, to such an extent that the elastic reaction of the material of the beam is greater than the downward energy of the load. No such increased deflection would take place if the beam were held down to the two units of deflection by means of a tie rod below. The application of the load would simply relieve the tie rod of one-half its tension, but produce no further deflection. We see then that the greater apparent potency of moving loads is a function of the bridge or beam rather than of the load, and need only be considered as such.

Now, there appears to be a tendency amongst the new method advocates to produce a formula for allowable stresses which shall be general in its application to any part of a structure simply by modifying LAUNHARDT's formula in such a manner as to give increased weight to live load stresses equally throughout a whole bridge, irrespective of the position of the various members and varying merely as the span of the structure. Such a general formula can hardly be accepted as filling in any sense modern demands in bridge construction, and we would remark here in passing that the results arrived at by the new method are already very closely attained by our leading bridge specialists, who, whilst working on certain general lines, modify their structures in accordance with every day practical experience so as to accord with what theory shows to be correct, and the practical men have undoubtedly first shown the way to the theorists.

The more correct method of dimensioning would appear to be by some formula resembling LAUNHARDT's, which shall be general and take into account the ratio $\frac{Min.\ S.}{Max.\ S.}$ of least to greatest stress in each member. The minimum stress will, in a tension member, be either 0 or the dead load *minus* the counter load stress and the maximum stress will be the dead load *plus* the live load *plus* a percentage of the live load for impact, etc., and as this addition varies with the position of the members considered, no simple formula will be of general application and the ratio $\frac{Min.\ S.}{Max.\ S.}$ must be determined for each separate piece for use in the general formula. As time is an important element in the application of a load it is clear that the time elapsing between the first entry of a train upon a bridge and its attainment of such position as gives maximum stress in a certain member is to be considered in determining the impact addition. The prominent English bridge engineer Mr. B. BAKER, who more than most other foreign engineers has profited by American practice, speaking of the dimensioning of the Forth Bridge said: "We did not bind ourselves by any formula derived from the experiments of WÖHLER and others, but considered each member separately:" and this is just what numerous American engineers have been doing for some time past, as witness the variation of working stress in counters according to position.

As regards the disputed point whether floor beam hangers or counters are more exposed to sudden and severe loads, it may be argued that theoretically the suddenness of loading of a floor beam hanger is eliminated entirely by its initial tension, as floor beam hangers should always be tightened up beyond their maximum load tension. In daily work, however, nuts will slacken off somewhat, and it would not be good practice to assume the minimum load of a floor beam hanger to be greater than its dead load. Hangers therefore, as experience has shown, are more severely stressed than counters, which commence to take load as soon as a train enters a bridge, while a floor beam hanger is never more than a panel length removed from instantaneous load application.

The discussion on the new method is undoubtedly profitable, and we regard it as certain that the effort is in the right direction, and that in due time general practice will conform more closely to it, but before any great faith will be placed in the teachers or upholders of the new doctrine, greater uniformity must exist between the results set before us. Further, the minimum stress on a member is by no means that due to dead load. The influence of the live load and of wind serve to reduce still further the minima stresses and to increase the maxima, and it is a problem of no small complexity to determine to what extent the greatest supposed maxima and minima must be allowed for in any modified LAUNHARDT's formula. Mr. BAKER in the Forth bridge merely makes an arbitrary distinction between the stresses allowed for frequently occurring ordinary loads (*i. e.*, Dead + Live,) and the extraordinary loads produced by a super-added wind stress of very infrequent occurrence, and all this has already been done by our own engineers. The new method therefore requires further study and research before it can be generally adopted in any cut and dried shape, and until then it is doubtful if engineers of experience will allow themselves to be much influenced in their judgment, which is, after all, but the outcome of that truest of theory—the accumulated results of experience. It may be desirable, and we believe it is practicable, to generalize these results more completely than they have been, but it must first be made sure that the generalization is itself correct. The points chiefly calling for elucidation at the present time are the effects of impact on different members, and the effect of vibratory causes, such as were recorded in some interesting tests by Prof. ROBINSON. These are far more important just at present than anything else, and when once it has been determined what stresses are produced by certain *nominal* loads then will be the time to determine the proper sectional areas of the materials to resist the actual stresses.

We must confess however to no great interest in the efforts which are constantly making, now by one road, now by another, to whittle down the admitted margin of error and doubt to the lowest possible limit. It must needs be that such efforts be made, or engineering progress would stop, but woe to them who put too much trust in them, so that they do too little to make every structure *certainly* secure by an ample surplus of strength. The crying evil of our American bridge practice is this tendency to over-refinement in the computation of strains and in providing sections to sustain them, with little margin for further growth of loads and for the deterioration which must result with time. This tendency results directly from our system of letting bridges as a whole instead of by the pound, leaving the contractors to design them under specifications, and it is the only evil, so far as we can see, of that otherwise excellent system, to which we owe so much of the phenomenal progress of modern construction; but it is a great and crying evil. As it is as injurious to the interests of bridge builders as it is to those of bridge buyers, we may expect in time to see it done away with, at least in part, by the establishment of certain agreed conditions of strength and rolling load which all bridges must sustain, either by legal enactments or general agreement; and when this comes almost every thing which tends to give greater precision as to actual strains will be well, since it will facilitate making every part equally strong; but at present its tendency is rather to increase the delusive appearance of precision in strains which leads to so much close sailing in proportions, so that it is perhaps just as well to have every one continue to be reminded that there is a good deal that is uncertain about both the strains and the material, which requires a liberal margin as an allowance for ignorance. If stone structures were figured as closely as iron, how many would last through five years? It is fortunate rather than unfortunate that they cannot be so figured. Were one-third as great a factor of safety allowed for iron as there is habitually for stone, the iron structures would be better, cheaper and more durable than stone, and we should never hear of an iron bridge failure.

English vs. American Manufactures.

The articles on "Technical Education and Foreign Competition," which have lately appeared in the *Westminster Review*, are interesting reading but are rather curious reading from the American standpoint. That appearing in the August number holds that England was raised to her supremacy in wealth and prosperity through her inventions and machinery and the cheapness and excellence of her manufactures. And that she is now in danger of losing her industrial prestige through the more effective use of her inventions and machinery by rivals, who thereby have secured greater cheapness and excellence in their own manufacture. The author very sensibly objects to the policy of the so-called Fair Trader, who would stop the import into England of all superior foreign goods. He

says that no amount of protective duties will shut out the many attractive articles that enter England, and illustrates by the practice of the United States in this connection, which with the highest protective tariff in the world still buys more largely than any other country goods of superior manufacture to those made at home. People of educated taste will buy beauty and excellence at a high price rather than ugliness at a low price. And after acknowledging that the British workman is sadly behind his rivals in combining utility of purpose with beauty of form, the *Review* then points out the importance of better technical training in national colleges or schools.

But while the article referred to is in the main a very sensible one and advocates what would be undoubtedly for the benefit of England, the author throughout persists that the British workmen alone has contributed the ideas, the machinery and the materials with which other nations are now supplying themselves to the detriment of British interests.

This may be the fact in the sense that from a Boulton and Watts we might eventually evolve a Corliss engine, or a McCormick reaper from a sickle. The end in view is practically the same in both cases, but the means of arriving at that end are very different. Speaking for American manufacturers only, however, we should say that in a multitude of well known cases the ideas as well as the products had their birth on our own soil. In many cases the conditions surrounding the demand were exacting and made a cheapening of product absolutely necessary. But the public too was exacting, and while it demanded its wares at the lowest possible cost, it insisted upon it that they should also be thoroughly serviceable and beautiful at the same time. And this demand has been nobly met by our army of inventors and manufactures. A striking example of this policy of reducing cost while maintaining excellence was brought to our notice within the last few days. We were examining the wares of a manufacturer of table cutlery, etc., and while admiring the beauty of form were struck by the cheapness and doubted the quality until the manner of production was explained. Everything was made of steel, blade and handle, all in one piece, the handles were beautifully engraved apparently and the whole article silver-plated. But this expensive looking handle, to begin with, was really cheap; designs were made, and then by an ingenious process photographed upon the handle itself, which had been previously prepared for it, and the figure was then etched by acid without further work. A portion of the money saved on the handle was expended in a triple forging of the blade, originally made of the best of steel, and the product was in this case a carving knife of great excellence that, with its fork and steel of like manufacture and all in a handsome case, sold for $3. While this was an article of common use and so cheap that anyone might have it, it was good all the way through and handsome enough for use anywhere. It required brains to produce it, and every stage of its production was marked by some ingenious invention or adaptation of just the proper means to secure the end in view. It showed invention, progress and the intention of doing something better than had been done before.

It is this characteristic in American workmen that has stopped almost absolutely the importation of the products which make the bulk of British manufactures. While a great clumsy Birmingham lock, with a key that was big enough for a club, might have satisfied our grandfathers—and does yet the majority of English householders—it is rejected by Americans of all classes to-day. They obtain for about the same price a Yale lock—for example—that is much more secure, and yet has a key that could be used as a watch-charm. It is the same with almost every article that enters into the furnishing of our houses, or the tools of daily use. And it is because other nations are beginning to appreciate our products of this class, and are buying them, that England complains that she is losing trade and scolds her colonists for going "to the other shop."

So in conclusion we may again say to the *Review*, that the American rival is not indebted to the English workman, of the present generation at least, for either ideas or tools. Our inventors have a plethora of ideas of their own; and until England surpasses the mechanical product of these ideas, Americans will continue to make all they want for home consumption, and have a rapidly increasing surplus to dispose of in foreign markets. But it is a very good indication of progress to see that there are Englishmen who recognize the national fault and would mend it; and we wish them God-speed in the suppression of that policy of conservatism that has so long stood in the way of England's advance, and in the spreading of their new gospel of the better education of the masses.

Engineering Enterprises in China.

In connection with the reported formation of a $50,000,000 (late $25,000,000) syndicate which has obtained a concession to operate the telephone and banking business in China, which has excited such general interest, a gentlemen who has resided there for twenty years, and who since his return has been in constant communication with business affairs in that country, states the following interesting facts in regard to the attitude of the Chinese towards outside engineering and business enterprises, which may serve as a general answer to many inquiries which we are receiving. He says, the rigid conservatism of the Chinese, and their very limited home trade and ignorance of anything except a very limited system of banking, renders it reasonable to suppose that all such schemes will be likely to be entirely impracticable for at least many years. It is reported that large sums of money have been used to procure the alleged concessions, and this, with the reputation Mr. MITKIEWIECZ (who, by the way is not a count) and the well known absence of integrity in the Chinese government, seems to indicate that the reported concession is of very little importance as an enterprise. He confirms the general belief that it is the settled policy of the Government to prevent a foothold of Western civilization. A few years ago, it will be remembered, a railway 12 miles long, was built by foreigners, from Shanghai to Woosung, under a concession, but the Government was secretly opposed to it from the commencement and used the first pretext, on obtaining possession of it, for annulling the concession, and then destroyed the railroad. A late despatch says that they have destroyed all the telegraph lines in the province of Hupeh. There are other instances of the intriguing and underhand policy of the Government. Beyond a very limited territory upon the coast, such as the cities of Hong Kong and Shanghai, the whole interior is closed to the introduction of modern improvements.

It is difficult for an American to understand or comprehend the intense conservatism of the Chinese. Outside the city of Shanghai is a small European and American colony, living under a concession, in nineteenth century civilization. It is a fine town, with police, concerts, telegraphs, yachts and all modern improvements, which has existed under the noses of the Chinese for forty years. Across the bridge, there is not a vestige of this, but the civilization there is 2,000 years old, and just as it was in the year 500 B. C. The new town has made absolutely no impression on the native population. They will adopt nothing. This is indeed a part of their religion and arose from CONFUCIUS' doctrines, who said "I am in search of knowledge and look to antiquity for light." It is this intense conservatism which makes the industrial future of the Chinese so very doubtful. Their minds are keen, if they should get switched off from it, and adopt new ideas, but there is little immediate prospect of any such change. The standard of integrity is high among the commercial classes, but the government is underhanded. The Chinese, if forced to use modern tools and appliances, drop them and go back to their own ways when they are among themselves. They stopped advancing 2300 years ago, and all progress Western civilization has forced upon them since that time has been superficial.

Taking in view all facts, therefore, there would appear to be a poor outlook for telephones, banks, railroads and engineers in China, and we earnestly advise expectant engineers to give little thought to chances in that direction for some years at least.

We say this with full recollection of the many recent reports of decided action by the Chinese in favor of industrial progress. Two recent railway concessions are stated to have been made to English parties and the concessions to the Wharton syndicate in Philadelphia seems to be a very straight affair indeed. But while all these may come to something, the probabilities seem to us immensely in favor of nothing definite resulting except disappointment. At least there seems no probability of there being any large field for engineers in China for many years to come.

Oliver Evans and the Locomotive.

A correspondent of the New York *Times* calls attention to the well-merited claims of OLIVER EVANS as the inventor of the high-pressure steam-engine, and consequently of the locomotive, and suggests the propriety of celebrating in the present year the centennial anniversary of this important event.

As to the date, we have looked the matter up for ourselves and find that EVANS himself says that while apprenticed to a wheelwright, in 1772, he labored to discover some means of propelling land carriages by other means than animal power. After experimenting with treadles and ratchet wheels worked by men, he witnessed the results arising from a gun-barrel filled with about a gill of water, tightly wadded, and then having the breech-end inserted into a blacksmith's fire. While the purpose of the original experimenters was only to make a noise, it suggested to EVANS the power of steam, and he at once set to work to utilize this discovery in his road-wagon. In 1786 his invention had so far progressed that he petitioned the Legislature of Pennsylvania for a patent and the exclusive right to his improvements in flour-mills and steam-wagons. The committee to which the matter was referred patiently heard all about his flour-mills, but when he suggested steam as a motive power on roads, they thought him insane, and while granting a patent for his improvements in the manufacture of flour, they took no notice of his steam engine. He was more successful with the Legislature of Maryland, and on May 21, 1787, he obtained a patent granting to him and his heirs the exclusive right for 14 years to make both his new flour-mills and his steam-wagons in that State.

He at once set to work upon the latter, and in 1789 endeavored to persuade Messrs. ELLICOTT BROS. of Ellicott's Mills, to join him in the expense and profits of making and using steam-wagons worked by engines on the high-pressure principles; but they feared the difficulties and while adopting the mill patents declined to have anything to do with the

steam-wagon. In Baltimore he attempted, with similar want of success, to enlist Mr. LEVI HOLLINGSWORTH, a prominent merchant, in his schemes. EVANS then went to Philadelphia, in 1800, and laid his plans before ROBERT PATTERSON, Professor of Mathematics in the University, and also before Mr. CHAS. TAYLOR, a steam-engineer from England; they both declared the principle new and worthy of a fair experiment. Mr. B. H. LATROBE, SR. pronounced the scheme chimerical, and publicly attempted to demonstrate its absurdity in a report to the Philosophical Society of Pennsylvania. EVANS then expended $3,700, all the money he could command, in the construction of an engine, with 6-in. cylinder and 18-in. stroke. He succeeded in putting it to work grinding plaster of Paris at the rate of 12 tons in 24 hours, and also exhibited it attached to a stone-sawing machine.

As early as 1803-4 he actually constructed a steam-wagon; or rather he put wheels under a heavy scow, fitted with a 5 H. P. high-pressure engine intended to operate a dredging machine, and by a belt connecting his fly-wheel and the wheels under the scow he ran his machine 1½ miles to the Schuylkill river, in Philadelphia, and then substituting a stern paddle-wheel for the others, he transformed his rig into a steam boat, and ran it about 16 miles in the Schuylkill and Delaware rivers, beating all sailing vessels in his path, even with this rude contrivance. On Sept. 26, 1804, EVANS proposed to run steam-wagons over the turnpike between Philadelphia and Columbia, Pa. He estimated that his engine would cost $1,500, his carriage, heavy enough to carry 100 barrels of flour, $500, and he added $300 more for unforseen contingencies. He promised to make a speed of 2 miles per hour and to save much money on the ordinary teaming, but the turnpike company would have none of it. To answer certain wise men who ridiculed his ideas, EVANS wagered $300 that he could make a carriage go by steam faster than a horse over level roads, and also announced that he could build a carriage "to run on a railway at the rate of 15 miles per hour." But the unfortunate inventor was ahead of his day, and capitalists persistently refused to take stock in his inventions.

As showing the faith of EVANS in the future of his steam-carriage we have a letter written by him to the New York *Commercial Advertiser* about this time, in which he makes a prophecy long since almost literally fulfilled. In this letter EVANS says:

"The time will come when people will travel in stages moved by steam engines at 15 to 20 miles per hour. A carriage will leave Washington in the morning, breakfast at Baltimore, dine at Philadelphia, and sup at New York on the same day. Railways will be laid of wood or iron, or on smooth paths of broken stone or gravel, to travel as well by night as by day. A steam-engine will drive a carriage 180 miles in 12 hours, or engines will drive boats 10 or 12 miles per hour, and hundreds of boats will so run on the Mississippi and other waters as was prophesied thirty years ago (by FITCH); but the velocity of boats can never be made to equal that of carriages upon rails, because the resistance in water is 800 times more than in air."

In 1803 EVANS actually built a high-pressure engine for a steamboat, which was to run between New Orleans and Natchez on the Mississippi. But the hull intended for it having been destroyed by fire the engine was utilized for many years in a Louisiana saw-mill. In an address on railroads, published in Philadelphia in 1813, while his conception of a road-bed and the details of his engine and train were naturally crude, EVANS boldly fixed upon the slope of 2½°, fixed by law for highways, as his limiting gradient for engines. This is the equivalent of a 4.37 per cent. grade. In this same address he offers to take stock to the extent of $500 per mile for 50 or 60 miles in any new railroad, "payable in steam-carriages or steam-engines, *invented for this purpose forty years ago*," and further offers to make his steam-engines run 12 to 15 miles per hour or take them back. This statement would run his inventions back to 1773, about the date he fixes as that of his first successful experiment.

OLIVER EVANS struggled manfully, but in vain, against the want of public enterprise and the almost universal doubt in the feasibility of his inventions, and from lack of private means he was finally compelled to turn his attention in other and more lucrative directions. He appreciated the slowness of the times and said—"It is too much to expect that the prodigious leap from bad roads to railways for steam carriages will be made at once; one step in a generation is all that we can hope for. If the present generation shall adopt canals, the next may my railways with horses, and the third generation may use the steam-carriages." He further says:

"But why may not the present generation, who have already got good turnpike-roads, make the experiment of using steam-carriages upon them. They will assuredly effect the movement of heavy burdens with a slow motion of 2½ miles per hour: and as their progress need not be interrupted they may travel 50 to 60 miles per day of 24 hours. This is all I hope to see in my time; and though I never expect to be concerned in any business requiring the regular transportation of heavy burdens on land, because if I am connected in the affair of a mill, it shall be driven by steam and placed near some navigable river to save land carriage, yet I certainly intend, as soon as I can make it convenient, to build a steam-carriage that will run on good turnpike roads, on my own account, if no other person will engage in it. And I verily believe that the time will come when carriages propelled by steam will be in general use, as well for the transportation of passengers as goods, travelling at the rate of 15 miles per hour, or 300 miles per day."

There is always something sad in the detail of the trials, heart-aches and disappointments of an inventor who is wiser than his generation, and has ideas that are capable of development into a something that would bring about great public gain, but which only subject him to ridicule and rebuff or the charge of insanity. This was the fate of EVANS, and other men now wear the laurels which properly belong to him. TREVITHICK and VIVIAN have stolen his crown, and 20 years after the American, OLIVER EVANS, actually patented his device of a high-pressure engine, these two men obtained English patents for what was simply a crude imitation of EVANS' engine, even if it was an original invention. Along with the American engine they took the cylindrical flue boiler which was also used by EVANS 20 years before TREVITHICK and VIVIAN were known in connection with the steam-engine. But they have the monuments and the honors, and the claims of OLIVER EVANS are even ignored by his own countrymen, or at least, they have never publicly and fitly acknowledged the works of the ingenious and persevering American inventor who first suggested and actually worked out the machine that, slowly perfected, has revolutionized the world, and pushed it further forward in one-half of a century than it had advanced in many centuries preceeding.

CORRESPONDENCE.

Electricity in Pile-Driving.

RAMSEY, N. J., Sept. 11, 1887.

EDITOR ENGINEERING NEWS:

An application of electro-dynamics has occurred to me in the course of my studies, which may be a new one and of interest to some of your readers; namely, the use of powerful electro-magnets in connection with drop-hammers. Among other devices where they could be substituted to possible advantage, would be in pile-drivers, replacing the jaw clutch. The fact that the attractive force varies as the square of the intensity of the current would make the application of special value for very heavy rams. For pile-driving the wire conducting the electric current could be inserted in the center of the rope supporting the helices, the latter moving in guides and lifting and dropping the ram as the current passes and ceases to act.

The application of the same idea to machinery, would be a matter of some ingenuity and great utility, although it would require considerable capital to compete with established lines of manufacture.

B. H.

[While we have no doubt that electricity could be applied in the direction indicated, the question arises as to the relative economy over existing methods, and the fact that a dynamo would be a rather troublesome bit of machinery on a pile-driving scow, for example, as far as the operators are concerned.—ED. ENG. NEWS].

Highway Bridge Failures.

KANSAS CITY, MO., Sept. 6, 1887.

EDITOR ENGINEERING NEWS:

Wishing to obtain some data concerning highway bridge failures in the United States, I write to ask the aid of yourself and your readers. Of course, the data are for publication, but it is my intention to give no names of parties responsible in any way for the accidents.

My object is simply to endeavor to effect a sadly needed improvement in the designing of highway bridges. It is my intention to publish a little pamphlet entitled "General Specifications for Highway Bridges of Iron and Steel," divided into chapters on Highway Bridge Failures; How Bridges are Built; How Bridges ought to be Built; Bridge Lettings; A Proposed Association of Highway Bridge Builders; General Specifications, Etc. The last chapter will be as complete in every particular as I can possibly make it. The first chapters will be of a popular character, and in them I wish to give a concise summary of the highway bridge failures that have occurred during the last ten years.

The data required would come under the following headings:

1st. Location of bridge.
2nd. Description of structure.
3rd. Dates of erection and failure.
4th. Cause and description of failure.
5th. How the defective structure was replaced.
6th. Any other items of interest.

Any aid furnished me in this compilation will be thankfully received and properly acknowledged.

If I do not here remark that my object in writing the pamphlet is a purely professional one, it will probably soon be necessary to do so, for those who advocate reform of any kind must expect to have their motives attacked.

Very respectfully yours, J. A. L. WADDELL

PERSONAL.

Mr. THOS. J. WHITMAN, M. Am. Soc. C. E., Water Commissioner of the city of St. Louis, Mo., has been engaged as one of the sewer experts for the city of Milwaukee, Wis.

Mr. J. C. CHASE, Superintendent of the Clarendon Water-Works Co., of Wilmington, N. C., has been elected City Engineer of Wilmington.

Mr. GEORGE H. FROST, of this journal, and his son and brother returned from Europe on the *City of Rome*, on Sept. 9; after a somewhat extended tour in the North of Scotland and a run to Switzerland by way of the Rhine.

Mr. OLIVER H. P. CORNELL, brother of Ex-Gov. CORNELL, was nominated on Wednesday last by the Republican Convention at Saratoga as State Engineer and Surveyor of New York.

Mr. WILLIAM FORSYTH, Mechanical Engineer of the Chicago, Burlington & Quincy Railroad, was married on Sept. 7 to Miss FRANCES D. PRIESTLEY, of Eastport, Me.

Mr. WILLIAM HALE, we learn, was erroneously stated in our issue of Sept. 3, to have had charge of a large part of the original location of the Vermont Central. Mr. HENRY R. CAMPBELL was Chief Engineer of the old Vermont & Canada, and personally supervised every part of the work, while Mr. JACOB M. CLARKE, Col. MOORE (now of the Central of New Jersey) and CASSIUS CHESBROUGH, brother of the better known E. S. CHESBROUGH, had immediate charge of most of the location.

SOCIETY PROCEEDINGS.

The American Society of Civil Engineers.—The Subscriptions to the Building Fund, are to date as follows:

Subscription previously reported	$7,810
Charles H. Myers	25
George B. Nicholson	100
Thomas C. Meyer	100
Wilson Crosby	20
	$8,055

The Montana Society of Civil Engineers, at a meeting on Aug. 27, adopted the following resolutions in memory of Col. J. B. CLOUGH, of whom quite an extended sketch was given in our issue of Sept 3:

Whereas, In the dispensation of an all-wise Providence, we are called to mourn the sudden death of our much beloved and highly respected brother engineer,

Col. J. B. CLOUGH, who has been suddenly removed from a field of the highest activity and usefulness:

Therefore, desiring to express and put on record our profound sense of the eminent worthiness, purity and integrity of his life, be it

Resolved, By the Montana Society of Civil Engineers, that his career has been distinguished for sincerity and singleness of purpose, for fidelity to his trust, for conscientious discharge of duty, and great consideration for the rights and feelings of others. Kindness was a distinguishing characteristic. Few were more fortunate in winning friends. His life has been a worthy example. His work has been of the highest utility to society. Important trusts committed to his charge bear witness to his ability. In his professional life he stood high; in civil and social life he was without stain; in domestic life, irreproachable; in all relations of life, a Christian. We will revere his memory and strive to emulate his example.

And be it further resolved that this society tender to his family its heartfelt sympathy in this, the hour of their great bereavement, and that a copy of these resolutions be spread upon the minutes of the society and forwarded to his family, and be published in the daily papers of this city.

J. T. DODGE, President.
J. S. KEEBL, Secretary.

The Proposed New York Engineers' Club.—The following circular in reference to a proposed social organization of engineers and men of practical science which has been under consideration for some time has recently been issued.

DEAR SIR: The plan of establishing in New York a social club for Engineers, which will bring the members of the several branches of the engineering profession into closer personal relations and afford a convenient headquarters for non-resident engineers during their visits to this city has been so far considered that it is deemed desirable to ask from those for whom the subject is likely to have interest an expression of opinion in the matter.

Such a club would depend for its original character upon the number of engineers willing to join it. With a small membership, small initiation fee and low dues, it would need to be started on a scale of limited accommodation and with a grill-room instead of a well appointed kitchen. With a large membership, and initiation fees and dues sufficiently liberal, a first class club can be established.

It is proposed to call a meeting for organization as soon as 250 eligible gentlemen in good standing as members of representative Engineering Societies have signified their willingness to join. For these charter members, the initiation fee would need to be not less than $25, and not more than $50. The initiation may then be increased to such amount as the club might direct. The annual dues would be more or less according to the accommodations desired. If such a commodations as other successful clubs afford are expected, the dues would need to be not less than $35, and probably not more than $35.

It is proposed to found as a permanent possession of the club, an engineering library, which by purchase, donation and bequest will, in time, become of great value. The plan does not contemplate any movement in the direction of a common headquarters for the principal engineering society. It is a social club only, and as such will commend itself to the approval of many who would regard with disfavor any attempt to bring the Civil Mining and Mechanical Engineering Societies together.

This inquiry is designed merely to call out an expression of opinion, and a favorable answer is not understood as obligating the person making it to become a member. It is expected, however, that the responses will indicate the intentions of a majority of those from whom they are received.

For a name, the Engineers' Club and the Holly Club have been suggested.

Will you favor the gentlemen, whose names are signed below, with an expression of your views on the third page of this circular, detatch the same and return under cover of an envelope to Mr. JAS. C. BAYLES, Box 1,415, New York P. O., who will act as temporary Secretary of the committee?

COMMITTEE.—Thomas Egleston, Edward Cooper, Henry R. Towne, R. W. Raymond, W. G. Hamilton, B. S. Church, Charles Macdonald, James A. Burden, J. C. Bayles, Charles Kirchhoff, Jr., W. B. Cogswell, David Williams, C. A. Stetefeldt George W. Maynard, J. C. F. Randolph, W. B. Kunhardt C. M. Bellows, Theodore Cooper, E. G. Spilsbury, J. H. Janeway, Jr., J. F. Lewis, W. H. Adams.

LATEST CHANGES OF ADDRESS, AMERICAN SOCIETY OF CIVIL ENGINEERS.

E. C. APPLETON, Res. Eng. Chicago, Kansas & Nebraska Ry., Belleville, Kan.

FRANKLIN I. FULLER, Smith & Watson Iron Works, Front and Harrison Sts., Portland, Ore.

GEO. W. KITTREDGE, Engr. Maintenance of Way, Jeffersonville, Madison & Indianapolis R. R., 14th and Main Sts., Louisville Ky.

R. H. TEMPLE, Ch. Engr. Tennessee Midland Ry., and Virginia Construction Co., Memphis, Tenn.

C. FRANK ALLEN, Mass. Ins. of Technology, Boston, Mass.

WALTER A. DOANE, Care Oregon Pacific R. R., Corvallis, Ore.

FRED. EATON, City Engineer, Los Angeles, Cal.

J. FOSTER FLAGG, 16 Lafayette Ave., Brooklyn, N. Y.

WILBUR F. GOODRICH, Leominster, Mass.

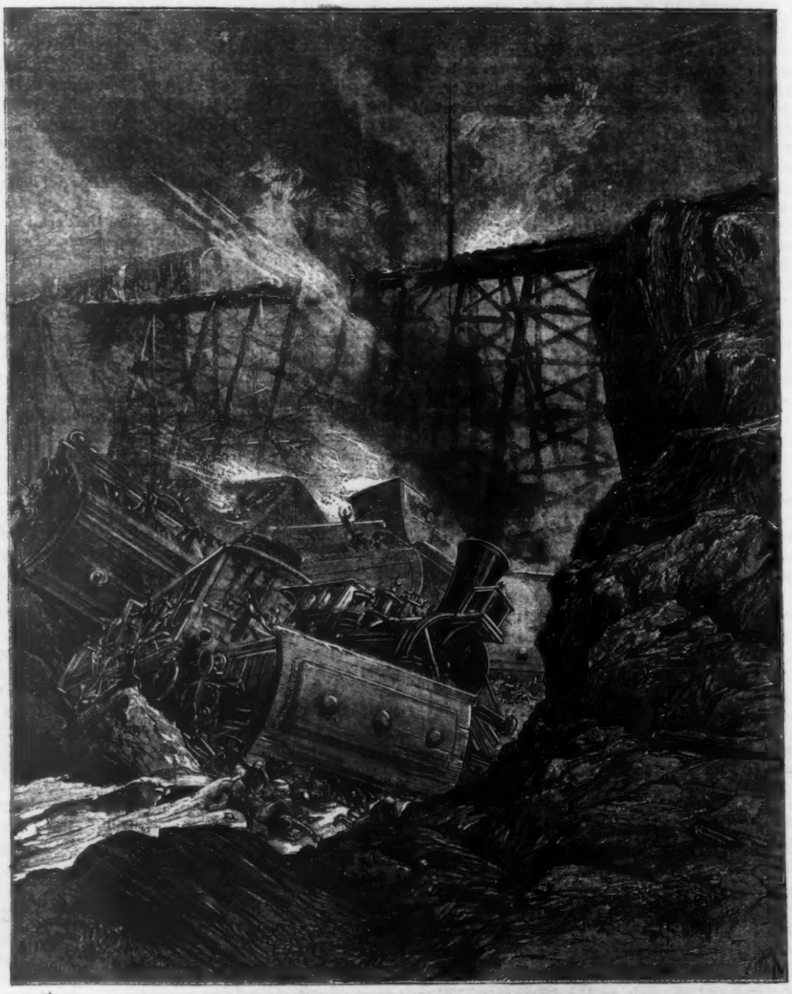
SILVANUS MILLER, Jr., Guatemala City, Guatemala.

W. HARRISON SMITH, Engr. Carnegie Bros. & Co., (L'td. 48 Fifth Ave., Pittsburg, Pa.

Land Reclamation in Indiana.—State Geologist THOMPSON, of Indiana, says that many thousands of acres of rich land lie on either side of the Kankakee river, and are practically submerged owing to a lack of drainage. He thinks that to straighten the course of the river and drain the whole swamp region would be comparatively easy and inexpensive work.

The Chatsworth Disaster as Seen Through French Spectacles.

Having been disappointed in our efforts to get good and early views showing the technical features of the late Chatsworth disaster, as our readers will remember, and been able to present only two or three miserable little views and drawings, we avail ourselves of the first opportunity to supplement our own deficiencies by falling back upon French enterprise for a view bearing some adequate relation to the magnitude of the disaster. The view we now give is a reduced copy of a large full-page engraving which appears in *Le Journal Illustré* of Aug. 25,



LA CATASTROPHE DU NIAGARA

Dessin de Henri Meyer. — Gravure de Mahler. — Voir l'article, page 778.

The Chatsworth Disaster as seen through French Spectacles.

1887, or only 15 days after the disaster, which is certainly prompt work. Our own illustrated papers did some almost equally prompt and good work, but honor to whom honor is due,—the French have a clear lead this time. The only serious error that we notice in connection with the view is the very natural assumption that an excursion train to Niagara Falls must have been running on the *Chemin de Fer du Niagara*. The cars have a somewhat peculiar look, and the people around and on them would seem to be rather French than American in size, but the locomotive is distinctively American, and so also is the trestle. Niagara Falls lie just below the trestle, out of the field of view.

The Strong Locomotive Tests.

The Strong locomotive is a most interesting experiment involving as it does two of the very few radical departures from the original type of locomotive, which have ever been tried with apparent prospect of success, viz.: the corrugated duplex boiler and a peculiar gridiron slide-valve. It is a strange and significant fact that no single deviation of type from the machinery of the original Rocket has yet been made which has been successful. The changes have been of proportions and minor details only. Moreover, the development of the locomotive instead of tending to diversity, has tended rather to unity of type. There are dozens of different forms of stationary engines of approved merit for various uses, but all the differences in the locomotives of the whole world, of any significance, are in the running gear. The boilers and machinery proper are always much the same in their design.

The Strong locomotive makes a very radical departure in its boiler, and one which certainly seems to have much in its favor. The gridiron valve is also a considerable departure, although in our judgment one of less promise and less importance. These facts lend great interest to a report by E. D. LEAVITT, Jr., of Cambridge, Mass., which sheds a good deal of light on what may be expected of this engine, or rather hoped, for the report is by no means broad enough in its scope or complete enough in its details to be said to be decisive, while there is in places more of the tone of a retained advocate and less of the tone of an impartial judge than we like to see in such professional documents. We postpone a summary of the main part of the report until a following issue, for lack of space, giving first the dynamometric records of work done. The experi-

ments were made in August last and conducted by Prof. KLEIN, of Lehigh University, but their manner of presentation is rather obscure. We, therefore, recast them for the most part in the following large table.

Dynamometer Tests—Strong Locomotive and Lehigh Valley Train.

Location and Date.	Speed miles per hour.	Tractive Force—Lbs.			Wt. Train—Long Tons.			% Wt. engine to train.	% resist. engine to train.	Resist. per ton cars, lbs.	Aver. grade and curve resist.
		Total (Indicated.)	Cars only (Dynam.)	Engine only.	Engine.	Train.	Total.				
Sugar Notch to Fairview, May 19	28.97	11,198	6,208	4,990	87	125	212	69.6	80.0	49.67	-
Sugar Notch to Fairview May 21	28.66	12,220	7,930	4,290	87	174	261	50.0	51.0	45.57	
Mauch Chunk to Penn Haven Junction, May 19	30.34	8 813	5,381	3,432	85	200	285	42.5	63.0	26.90	14
Penn Haven Junction to White Haven, May 19	38.84	7,549	4,635	2,914	85	200	285	42.5	62.9	23.17	13
White Haven to Glen Summit May 19	33.93	10,945	7,540	3,405	85	200	285	42.5	45 1	37.70	62

The last column, is a mere guess at the average of a large table which is so very detailed (giving the resistance separately on each curve and break of grade) as to be practically useless without a most elaborate calculation for which sufficient details are not given. It indicates clearly enough, however, that the car resistance was in the neighborhood of 12 lbs. per long ton (10.7 lbs. per short ton) at speeds of 30 to 39 miles per hour, and was but little affected by speed. This is probably very nearly correct, corresponding very well with all the more recent tests, and giving renewed indication that there is no money in slow speed for freight trains if brakes and couplings were fit for high speed.

The car resistance includes the head resistance of the first car behind the tender, which is a comparatively small matter. The comparative engine resistances may be determined as follows: The rolling resistances proper may be taken as the same per ton as for the cars, (it is a common and mistaken impression that they are considerably higher). Multiplying this rate per ton by the weight of engine and tender we get the total engine rolling resistance, in pounds and what is left of the observed total (difference between indicated cylinder work and measured car resistance) should be the engine head resistance This checks out as follows for the successive tests above.

	Engine Resistance—lbs.		
Speed	Rolling only	Total	Leaving as head
2.9	4291	4990	649
38.7	3965	4290	325
30.3	2286	3434	1148
38.8	1970	2914	944
33.9	3204	3405	202
Average lbs.			657

This being at an average speed of about 30 miles per hour corresponds to about 0.73 V^2 for the total engine head resistance in pounds, which corresponds very closely indeed, considering the rude way of determining it, with the best results of other tests, which range from 0.63 to 0.83 V^2, the latter being the most probable figure.*

These tests therefore have every probability of essential correctness. The same is by no means true, however, of the deductions from them, as shown in the accompanying diagrams taken from the dynamometric records of the tests, the interpretation given to which is a sad case of the distortion of evidence, conscious or unconscious. The diagrams are thus described, all italics being ours:

"On May 20th a train of 30 coal "jimmys" was drawn from Sugar Notch to Fairview (with the dynamometer car attached) by one of the heaviest Lehigh Valley "Consolidation" freight engines. The engine had 20×26-in. cylinders, and eight-coupled 50-in. drivers: weight about 114,000 lbs.; tender, about 80,000 lbs.; train, including dynamometer car, 631,000 lbs. or 281.7 long tons.

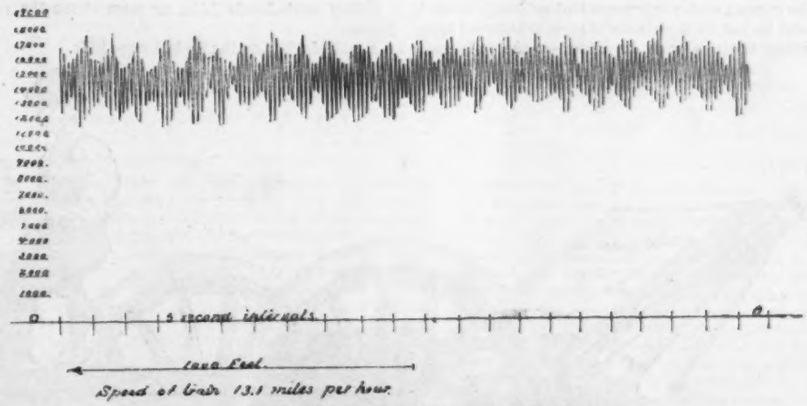
"Strain diagram A *fairly represents the action of this locomotive.* The portion shown was taken on a 96 ft. grade and on a 16° curve and *at a speed of 13.1 miles per hour, when the locomotive was working at its best.*

"Strain diagram B is a portion of that taken on May 20, with engine No. 444, (the Strong engine) the portion shown being taken at precisely the same portion of the road as diagram A, viz.: on 96 ft. grade and 10° curve, *but at a speed of 27.2 miles per hour.* As previously stated, the weight of train at this time was 174 tons.

"*Nothing could more strikingly represent the action of the steam in these two engines than the strain diagrams.* The revolutions of the drivers of Engine No. 82 can be accurately taken from the strain diagram, every cusp on either side of the curve representing a revolution.

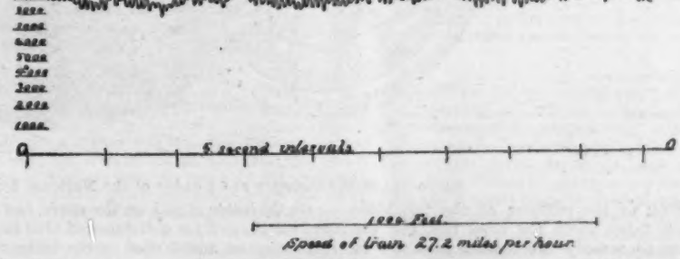
"*It is obvious from this diagram (A) that one end of one cylinder was doing more work than the other end of the other cylinder. Hence the great oscillations in the diagram.* It is also to be noted that the train, as a whole, had its rate of oscillation about every six or seven revolutions of the drivers. *This could easily be detected on the train independent of the strain diagram.*

Speed of trains—
Engine No. 82..... 13.1 miles per hour
Engine No. 444..... 27.2 miles per hour



Strain Diagram "A." Locomotive No. 82.
[A Consolidation, hauling 30 four wheel coal cars.—ED.]

Cylinders, 20 in. x 26 in.; drivers, 50 in. diameter; *weight of train*, 281.7 *long tons*; 96-ft. grade; 10° curve; *speed*, 13.1 *miles per hour*; net horse-power, 527.4; net tractive force, 15,097 lbs.; tractive force per ton, 53.5 lbs.



Strain Diagram "B," Locomotive No. 444.
[A Strong locomotive, hauling passenger train.—ED.]

Weight of train 174 *long tons*, same track. *Speed*, 27.2 *miles per hour*. Indicated horse-power, 992.4; net horse-power, 632.3. Net tractive force, 8,718 lbs.; tractive force per ton, 50.1 lbs.

"Net tractive force and resistances in pounds per long ton as given below the diagrams. Calculated resistances from Mr. Wear's tables, in pounds per long ton:

	Pounds.
Due to 96-ft. grade	40.3
Due to 10 degree curve	11.3
Total due to grade and curve	51.5

"The mean of 53.5 and 50.1 is 51.8 lbs. which is substantial evidence of the accuracy of Mr. WEAR'S tables.

"The indicated horse-power at the time diagram B was taken is as follows: Mean effective pressures in lbs. per sq. in.—

	P. R. End.	Front end.
Right hand cylinder	87.64	85.84
Left hand cylinder	90.21	82.46
Total	178.85	164 32
Indicated horse power, P. R. end	484.3	
Indicated horse-power, front end	468 1	
Total indicated horse-power	952.4	

This report is signed by J. S. COON, who made the tests for Mr. LEAVITT, and more misleading comments could hardly be made in respect to what the diagrams really show. The contrast between them is chiefly, if not wholly, due to two causes: First, the difference in speed and load, one engine being working hard and slowly, and the other fast and easily, and secondly and chiefly to the difference in the character of the trains, one being made up of five or six close-coupled passenger cars, and the other of thirty wabbling and thumping freight cars. Any engine whatever when working hard and slowly with such a train will make a diagram closely resembling *A*, but no engine will continue to do so long, unless there is something abnormal about it. If this engine did so, which is higaly improbable (but which is distinctly implied), it merely indicates that it was not a fair sample engine and instead of parading its record it should be suppressed, as tending to throw doubts on the correctness of the entire tests.

On the other hand there is nothing in the least remarkable about the regularity of diagram "B," nor is it at all significant that it was obtained on the same piece of track of diagram "A." Any good engine will show as great regularity with that speed and train on long stretches of its record, although no engine will show it everywhere. That any irregularity in the action of the cylinders, other than such usual variations as the other engine likewise showed (as shown in the tabulation above) had anything to do with the contrast is not at all a necessary assumption and certainly far from "obvious." All such loose coupled trains lurch, if lurching be once started, even if the engine be hardly working at all, and that is unquestionably the chief cause of the contrast.

The contrast is no doubt a genuine one, however, in the sense that both diagrams are a correct extract from the actual diagrams, and while the wrong deductions therefrom should put us on our guard against accepting the conclusions given too readily, it in no way detracts from the interest of the actual records, which we shall summarize in a following issue.

*See "Economic Theory Loc. Railways" 520—528 for summary of facts on this head.

A Fine Specimen of Track.

The following is a brief statement of facts casually noticed by one of the engineers connected with this paper, as to the condition of a piece of main line track situated within five miles of the center of a large New England city. The road alluded to is a trunk line and, besides a large freight business, runs over fifty passenger trains per day over this track, the traffic amounting to over 7,000 passengers daily, or nearly a million and a quarter in the course of a year. It is introduced not so much for the instruction of engineers as by way of warning. The matter has since, we understand, been remedied on notice from the Board of Railroad Commissioners of that State, to whose attention the state of affairs was called by our correspondent.

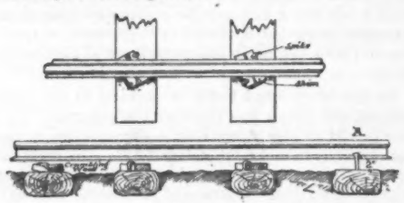


Fig. 1.

The ground under this track had evidently settled several inches, for a distance of several hundred feet, carrying the ties with it. This left the rails suspended, owing to the stiffness of the fish plate joints, about 2 ins. above the cross ties, and the course taken to remedy the matter is shown in Fig. 1.

Shims of short pieces of 2-in. plank have been run diagonally between the ties and bottoms of the rails, and insecurely fastened, as shown. These were nearly all loose, and our correspondent could push most of them out from under the rail with his foot, leaving the rails entirely unsupported on both tracks, at this point, over a distance of three or four ties. All these shims were badly cracked, many being in several pieces, and some crumbling with decay.

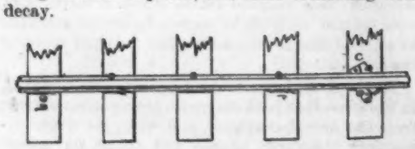


Fig. 2.

Fig. 1 at *A* shows how the spikes are drawn, there being ¼-in. or more between the under side of head of spike and the rail flange. This insecure fastening leaves the rails, which are not more than 25 ft. long at this point, practically unsupported or fastened except at the joints, the stiffness of the fish plates and form of lower rail flange alone keeping it from overturning.

Fig. 2 shows plan view of spike fastening. At *B* a spike is driven into the tie fully 1 in. clear from the rail, and there is no fastening on the inside of the rail for a space over two sleepers. At *C* an attempt has been made to keep the shim in place by

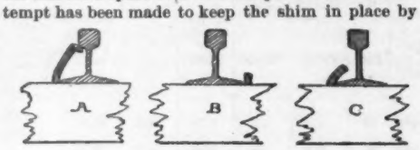


Fig. 3.

driving *board nails* through the shim into the tie. To be brief, taking an interesting walk for about half a mile, around a curve from this place, what was seen is shown in Fig. 3, and the writer made the following notes:

No support to the rail over two ties, in several places and at opposite points on both rails.

A rotten tie—no support.

On the curve, four ties without a spike to hold the rail on the inside of curve.

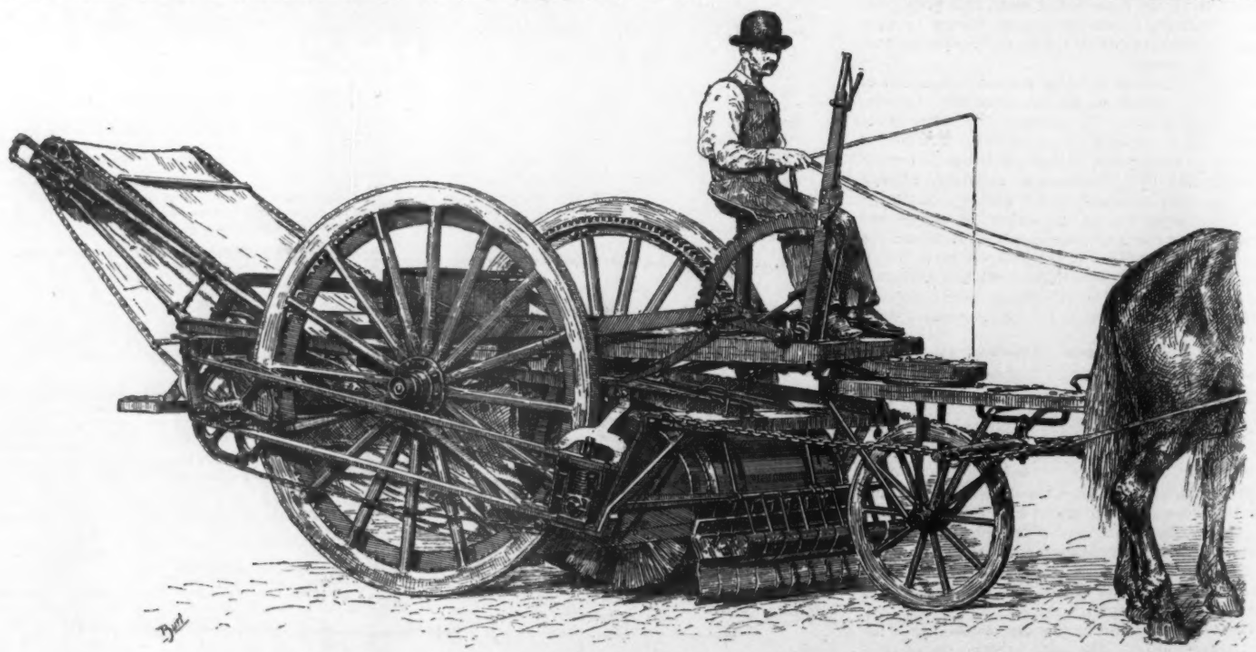
Heads gone. Heads gone and shank of spike bent over.

Spikes with heads ¼-in. or more above the rail flange.

A spike laying on the tie but none in it.

On the inside of rail on the curve, *but two spikes to hold the rail for a distance of nine ties.*

It may be added that on the bridges the guard rails appear to be too far from the track rails, the distance being over 8-in. centers.



Combined Street-Sweeper and Loader of the National Street-Sweeping Machinery Co.

A Combined Sweeper and Loader for Street Cleaning.

The combined sweeper and loader, herewith illustrated, is being introduced by the National Street Sweeping Company, of 330 Walnut St., Philadelphia. It is the first successful application of a device for sweeping the streets and loading the sweepings into an ordinary cart or wagon at one operation. Previous machines of this character combined the sweeper and receptacle for the dust, and no economy was possible as the sweeper had to be hauled to the dump as well as the dust; with the result of a loss of time and the waste in power in hauling a heavy machine further than the sweeping proper would demand. Other designs, including the dumping of the refuse in piles on the street and the use of a special and clumsy receptacle burdened with loading machinery, have also failed to meet the demand for such a machine.

The present device is little if any heavier than an ordinary street sweeper, but it has the decided advantage of collecting the dirt swept up and depositing it directly in a cart of the usual type, without the intervention of the Italian handler of the shovel and broom. The cut given is taken from a photograph and shows the special features of the device and its general appearance. In it the usual horizontal revolving broom is inclosed in a tight sheet-iron drum, having an opening at the bottom to allow contact with the surface to be swept, and another opening behind for the discharge of the material, which latter is thrown upon a simple conveyor belt and thus discharged into an ordinary cart or wagon temporarily attached to the rear of the sweeper.

The broom is run at a high speed, with the purpose of (1) increasing the power of the broom to do clean work and to lighten the load on the horses; (2). The high speed, even without a too stiff broom, picks up all manner of refuse, such as brick-bats, loose cobble-stone, etc. (3). The broom being enclosed in a tightly fitting drum acts, with this high speed, as a powerful blower and sucks in dirt below and discharges it at the rear on the conveyor belt. It thus sucks up particles lying in crevices below the touch of the broom itself. By an ingenious device the brooms are fed out towards the drum as they wear down and the drum is thus kept constantly full. The relative speed of the broom and forward motion of the machine is such that every part of the street surface is swept over three times.

In front of the broom-drum and extending to the surface of the roadway is a flexible curtain, simple in construction but able to automatically rise in sections over any obstruction or inequality in the streets. These sections are shod with cast-iron, both to prevent wear and keep them in place. If the obstacle is too great the broom can be raised; or it can be lowered, if desired, both by a lever at the driver's seat. When raised out of contact with the ground, the whole machine is thrown out of gear.

The whole machine is thoroughly well designed and is constructed of the best material, with iron and steel substituted for wood wherever practicable. All parts are made to standard patterns and every bearing and working part is adjustable for wear. When working the machine is a light load for two horses.

In connection with this machine is a gutter-sweeper. This is a one-horse machine that is used in cleaning the gutters and it throws the dirt towards the middle of the street where it can be handled by the sweeper-and-loader. This machine was illustrated and described in our issue of April 24, 1886, and is a very simple contrivance of a series of brooms mounted on a horizontal disk and revolving upon a shaft which is adjustable to any angle

within certain limits. As to the cost of doing work by the new system, the company say that at present prices for labor and horse-hire in Philadelphia they can do the sweeping, loading and dumping for 11 7/10 cts. per 1,000 sq. yds. of street surface, an economy of about 63 per cent. over present methods.

STATISTICS OF NEW WATER-WORKS CONSTRUCTION.

(Specially Communicated.)

CONTINUED FROM PAGE 174.

Prattsville, N. Y.—The works were commenced April 1, 1885, and accepted July 1, 1885; they were designed and constructed by FRANCIS LEONARD, of Norwalk, Conn. The pipe was furnished by the Norwalk Water Pipe & Construction Co., and the valves and hydrants by the Ludlow Valve Manufacturing Co., Troy, N. Y. The franchise is owned by the Prattsville Water Co.; President, FRANCIS LEONARD; Secretary and Superintendent, MARTIN CHAMBERLIN. The franchise is for 10 years, and the price per hydrant is $25. The present population of the village is estimated at 500.

Hobart, N. Y.—The works, which were designed by GEO. N. COWAN, were accepted Sept. 5, 1887. The contractor was FRANCIS LEONARD, of Norwalk, Conn.; the pipe was furnished by the Norwalk Water Pipe & Construction Co., and the Holyoke hydrants and Ludlow valves were used. The franchise is owned by the Hobart Water Co.; President, JAS. COWAN; Secretary, GEO. N. COWAN. No contract has yet been made between the town and the company. The present population is estimated at 1,000.

Kent, O.—The works were commenced in October, 1886, and have been recently completed; they were designed by ISAAC S. CASSIN, who also acted as Constructing Engineer. The contract for the works, complete, was taken by the Holly Manufacturing Co., of Lockport, N. Y. The water is taken from Plum creek, and there is a storage and subsiding reservoir in the creek with a capacity of 10,000,000 galls. There are about 8 miles of 4-in., 6-in., 8-in., 10-in. and 12-in. pipe, and 77 fire hydrants. The top of the stand-pipe is 200 ft. above the pumping station. The franchise is owned by the Kent Water Co.; President, ARCHER N. MARTIN; Secretary C. G. HILDRETH; Superintendent, ALEXANDER B. YOUNG. The franchise is for 20 years, and the price per hydrant is $50. The present population is estimated at 4,000.

[TO BE CONTINUED.]

NOTE.—The above statistics of new construction are sent in response to special inquiries sent out by us to contractors, superintendents, engineers and others having to do with new works. We have a special blank for this service, and will be pleased to forward one or more on application. We invite co-operation in this special subject.

CONSTRUCTION NEWS.

Water.

Stand Pipe.—The Florida Land & Colonization Co. will erect a stand pipe at the water works, Sanford, Fla.

Toronto, Canada.—The water works committee recommended that the Council should construct a 4-ft. conduit across the bay at a probable cost of $240,000, in connection with the proposed increase of the water supply.

Drainage Convention.—A convention has been called to be held in Peoria, Ill., Oct. 6, to give expression to the sentiment of the people on the proposed improvement connecting the waters of Lake Michigan with the Mississippi river by way of the Illinois and Desplaines rivers to Joliet and thence by canal to Lake Michigan. Citizens of Illinois and adjoining States are invited to be present. The call is signed by citizens of Peoria and Pekin.

Chattanooga, Tenn.—Work is progressing on the buildings for the new water works. The contract for the 12 filters has been awarded to the National Water Purifying Co., of New York. The pumps are being built by the Deane Steam Pump Co., of Holyoke, Mass.; they will have a daily capacity of 6,000,000 galls. The mains will be furnished by the Cincinnati & Newport Iron & Pipe Works, of Newport, Ky., and all the fittings by the Chattanooga Pipe Works. The contract for the stand-pipe has not yet been let; it will be erected on Fort Wood, will be 80 ft. high and 20 ft. diameter, and will enable the company to supply water at a higher level than can be done with the present reservoir. Superintendent WINGFIELD hopes to get the works completed and in running order, by January.

The Weather of the United States for the Month of August, 1887.

[As respects the elements of most interest to engineers.]
According to special returns from the Chief Signal Officer of the U. S. Army.

STATION.	Temperature. Degrees Fah.				Wind Velocity. Miles per hour.			Precipitation. Rain and melted snow. Inches.		
	Average	Max.	Min.	Range.	Average	Max.	Direction. Max.	Total.	Hardest in 24 hours.	No. rainy days.
NORTHERN CITIES.										
Northfield, Vt.	61.0	83.1	36.8	46.3	6.8	30.	N	4.53	1.13	12
Portland, Me.	64.8	85.8	47.5	38.3	6.9	45.	S	6.56	2.20	13
New York City.	71.4	78.9	65.2	13.7	7.6	33.	W	3.66	1.42	7
Pittsburg, Pa.	72.3	93.3	45.8	47.5	5.0	26.	SW	2.16	0.79	13
Chicago, Ill.	69.7	97.7	49.1	48.6	9.1	30.	NW & W	3.35	1.24	9
Omaha, Neb.	72.0	101.5	48.2	53.3	7.4	34.	N	3.94	1.50	11
St. Paul, Minn.	65.9	93.5	41.1	52.4	4.1	29.	W	3.37	1.08	14
Duluth, Minn.	62.4	94.2	46.1	48.1	6.5	31.	NE	1.51	0.50	13
Bismarck, Dak.	64.6	90.9	37.0	53.9	7.3	36.	NW & W	1.62	0.43	17
Average	67.1	90.9	46.3	44.7	6.7	32.		3.30	1.14	12
SOUTHERN CITIES.										
Washington City.	73.2	91.7	51.7	40.0	4.3	35.	NW	2.34	1.41	12
Louisville, Ky.	78.3	99.1	55.1	44.0	6.0	48.	W	2.74	1.84	4
St. Louis, Mo.	79.2	99.0	52.1	46.9	6.3	30.	SW	1.14	0.83	9
Savannah, Ga.	79.9	97.5	65.0	32.5	7.2	25.	SW. NE.E.	1.89	0.98	12
Leavenworth, Kan.	73.3	99.7	48.0	51.7	5.0	33.	N & SW	7.11	2.22	15
Jacksonville, Fla.	80.8	97.1	67.7	29.4	6.7	34.	S	5.76	1.96	14
Chattanooga, Tenn.	76.3	96.0	57.8	38.2	10.2	34.	N	3.13	1.72	11
New Orleans, La.	81.0	94.3	71.0	23.3	6.0	28.	NW	7.42	2.06	12
Memphis, Tenn.	78.9	97.5	58.6	38.9	4.0	28.	W	1.21	0.50	7
Palestine, Tex.	80.9	100.0	61.8	38.2	7.4	36.	S	5.18	2.42	8
Average	78.18	97.2	58.8	38.3	6.2	33.		3.79	1.59	10.5
FAR WESTERN CITIES.										
Helena, Mont.	63.0	87.1	40.2	46.9	5.9	35.	SW	1.86	0.66	12
Port Angeles, W. T.	55.1	81.5	38.7	42.8	4.2	24.	W	0.14	0.13	3
San Francisco, Cal.	56.4	73.8	48.7	25.1	11.5	36.	W	*0.00	0.00	0
Salt Lake City, U.	74.0	94.9	45.6	49.3	6.1	36.	S	0.69	0.34	8
Denver, Col.	67.9	94.6	46.9	47.7	6.7	48.	W	2.68	1.90	9
Yuma, Ariz.	90.9	112.5	59.5	53.0	7.0	26.	E & S	Trace.	Trace.	1
Santa Fé, N. M.	65.8	86.5	45.6	40.9	4.6	24.	NW.SW.W	1.57	0.50	12
Average	67.6	90.1	46.4	43.7	6.67	32.7		.99	.42	6.3

*.01 inch of fog during month.

Brockton, Mass.—The following order, prepared by the Special Committee on Sewerage, has been passed: That the committee on department of city engineer duly authorized by order of the City Council, approved Aug. 16 last, to employ a civil engineer to make a survey of the city for the purpose of establishing a system of grades, etc., be and they are hereby further authorized and directed in connection with said work to cause to be made contour maps which shall exhibit the drainage area of North Main street, Centre street, and of the Packard Swamp section; the total sum expended for work named in this and the other before named, not however to exceed the sum named in said order.

The Los Guilicos Water, Light & Improvement Co. has been incorporated at San Francisco, Cal., to acquire real estate, water rights and privileges, steam and horse railroads, and to improve, lease, and in any manner deal in the same; to supply water, gas and electric light and power for public and private purposes; to construct public and private buildings, and to conduct a general real estate business. Capital stock $250,000, in 5040 shares, subscribed by J. M. DONAHUE, N. W. GRISWOLD, A. S. RHOADES, W. J. J. MATHEWS and HENRY N. BIRD, of Cincinnati, O.

Montclair, N. J.—The temporary reservoir for the Montclair water works is now being put in on the summit of First Mountain, at the head of Watchung avenue. The reservoir will be 42 ft. in diameter and 30 ft. deep, and its elevation of 642 ft. above tidewater will give a satisfactory pressure upon the mains for the dwellings on the upper side of Mountain avenue, while the water in the reservoir will be 315 ft. above the D. L. & W. R. R. station at the lower end of the town. About 20 of the 25 miles of street mains have been laid, and many citizens have already had connections made with their houses, though the water is not to be turned on until October 1.

Waco, Tex.—For years Waco has been bickering over her water system. She has one system now, that of the Waco Water Company, and has two more in prospective, one to be owned by the city, the other to be built and owned by Inman Bros. of New York. Whether the latter two will ever materialize is yet to be seen. Today the Waco Water Company started to fill an immense reservoir on Dicky's hill, west of the city, with a capacity of 7,000,000 gallons, which it is hoped will solve the water question here, if it is a success. The supply of water is drawn from the Brazos river and an immense well in the southern portion of the city. The reservoir was constructed at an immense cost, under the supervision of Colonel W. R. Freeman, an engineer of ability, who is widely known throughout the State and who says the Waco water system is now equal to any he has seen in the State. Galveston, (Tex.) *News*, Aug. 26.

Water Supply for Irrigation.—The State of Nebraska is about to commence preliminary proceedings in the United States Court against the State of Colorado to compel the latter State to desist in its present practice of consuming all the water in the South Platte river. Nebraska wants an equal division of the water, and insists that for fifteen days of a thirty day month water in the Platte river should be permitted to flow unrestricted, and that the farmers of Colorado must close their boxes during that interval. There are a number of precedents, it is held, where one State has sued another and where satisfaction has been obtained, notably the suit between the States of New Jersey and Delaware over the jurisdiction of the waters of the Delaware river. This agitation is started not so much for the purpose of effecting results this year as to have the dispute satisfactorily settled before the incoming of next year's season.

Irrigation in California.—A company has been incorporated in Redding, Cal., for the purpose of taking water from the Sacramento river for irrigation purposes. The river will be dammed near Clear Creek, 12 miles above there, and 100,000 inches of water taken out. The company is composed of San Francisco and Redding capitalists, and the work will be pushed vigorously.

Hon. THOMAS FINDLAY, Superintendent of the California Water Co., the office of which is at Georgetown, El Dorado county, has about perfected arrangements to put across the American river to Placer county an abundant supply of pure water. The pipe will empty somewhere above Newcastle, and the company, of which Mr. FINDLAY is manager, has water in abundance for pretty nearly half the Sacramento valley, and for Sacramento city. The water will, under arrangements now contemplated, go to the big tracts of land near and north of Sacramento. It will require several miles of pipe to take the water across the American river into Placer county, but arrangements have been made for all the pipe necessary. Mr. Findlay has worked at this great project for several years.

County Surveyor Davis, of Fresno, has returned from the West Side, where he has been surveying a preliminary route for a new irrigation canal. The plan is to take the water from Kings river at the point where the new channel takes out and carry it across on an embankment from 25 to 30 ft. high in the lowest lands, and lead it across to the West Side lands. One branch of the ditch will be led south on the west side of Tulare Lake, irrigating over 100 sections of the land, while the main canal will be led south and will cover about 400 sections of land. The canal will be 100 ft. wide and 8 ft. deep. After striking the West Side plain it will go about 3 miles and then follow the contour of the country down to a point opposite Firebaugh's. The length of the canal will be about 70 miles. As soon as the preliminary surveys are completed they will be submitted to the projectors, who are from Watsonville and San Francisco, for their approval. There is but little doubt but that the work will be put ahead at an early date. Fresno *Expositor*.

The Arkansas City Land & Water Power Co. has been incorporated at Topeka, Kan., by C. K. Holliday, of Topeka; W. M. Sleuth, A. A. Newman, J. S. Hill and Stacy Matlock, of Arkansas City. Capital stock, $40,000.

Passaic Water.—Inspector LEEK has sent to Professors PETER T. AUSTEN and FRANK A. WILBER, of Rutgers College, samples of Passaic water, taken from the vicinity of the Jersey City and Newark intakes for the purpose of examination. On account of the recent heavy rains, the samples were found to be exceedingly dirty. The officers who procured the samples, reported that they found the river impregnated with great quantities of coal tar, coming from the factories along the river and from the gas-house at Passaic. The surface was also covered with crude oil, which had leaked from the Standard Oil ships, that are laid across Saddle river, one of the tributaries to the Passaic.

Providence, R. I. Sewerage.—No. 420. Resolution directing the City Engineer to make soundings and to present preliminary plans for the sewerage system. (Approved September 10, 1887).

Resolved: That the City Engineer cause borings and soundings to be made on location of the main lines of the sewers, pump works, and precipitation tanks, outfall, etc., and also prepare detailed plans of the various parts of the work necessary for carrying into effect the sewerage plan as adopted by the City Council, the expense of the same to be charged to the appropriation for sewerage.

In accordance with the above Resolution, soundings and borings are to be taken on the site to be occupied by the pumping station, on the areas to be covered by the precipitation tanks, along the line of the syphon crossing the Providence river, and on the lines of the various intercepting sewers. This work will be entered upon at once; detailed plans of the work are also to be made and it is expected early in the coming Spring, to let large portions of the work and to begin active operations.

Artesian Wells in Texas.—Quite a number of artesian wells are now being driven in different parts of the State, and many others are contemplated. At San Antonio water has been struck at a depth of 465 ft. The water is strongly impregnated with sulphur and is thought to contain iron and magnesia. Col. G. W. BRACKINRIDGE, of the same city, has begun boring a well near the reservoir, and has awarded a contract for a well on the high ground near the reservoir, to be driven to a depth of 3,000 ft. if necessary. Water has been struck near San Angelo, and work is progressing on the Gainesville well. At Waco the drill is down 650 ft. Dallas has contracted for the sinking of a well 650 ft. deep, to be carried down to 2000 ft. if necessary. At Denton the city has given $500 and the county commissioner $1 200 for an artesian well to be sunk in the public square of the city. The Denton Mill & Elevator Co. is sinking its well rapidly. Wells are to be drilled at San Angelo, Ennis and Ballinger. The wells for the Texas & Pacific R. R. at Bonham and Honey Grove have reached depths of 375 and 340 ft. respectively.

Racine, Wis.—At a meeting of the City Council on Aug. 17, the water works recently constructed by the Racine Water Co., were accepted. On March 18, 1886, a franchise was granted to the Racine Water Co. for establishing a water supply, and this company contracted with the Wisconsin Construction Co. for the construction of the works. The plans were prepared by Mr. GEO. E. ELLIS, C. E. The system adopted was the combined stand-pipe and direct pressure. There are 31.48 miles of 4 to 24-in. cast-iron distribution pipe, 299 gates and 310 hydrants. The pipe was furnished by Dunn & Long and Co., of Louisville, Ky.; the gates by the Coffin Valve Manufacturing Co., Boston, and the hydrants by the Coffin Valve Manufacturing Co. and the Clapham Valve Manufacturing Co., Boston. There are 3 river crossings; the trenching for which was done by Knapp & Gillen, of Racine, and the pipe laying by Thatcher & Breymann (*see page 139*). The work in the streets was done by day labor under the direction of A. W. INMAN. The intake well is 14 ft. diameter and 36 ft. deep below the ordinary summer level of Lake Michigan; it is separated from the pump well by screens. The suction pipe is 24 ins. diameter and from the pump well to the inlet curb is about 7,200 ft.

The pumping plant was furnished by the Geo. F. Blake Manufacturing Co., Boston Mass., and consists of 2 duplex engines with an aggregate daily capacity of 4,500,000 galls. One engine is compound and the other one high pressure; the cylinders are 12 and 24 ins. diameter; water plungers, 14 ins. diameter; stroke, 24 ins. There are 4 steel boilers, 72 ins. diameter and 16 ft. long; they were furnished by S. Freeman & Sons, of Racine. The masonry of the engine house was erected by James P. Corse & Son, of Racine. The stand-pipe is situated on high ground about 1¼ mile from the pumping station; the site is 55 ft. above the lake and the pipe rests on a concrete tower 55 ft. high; the bottom being therefore 110 ft. above the lake. The stand-pipe is of wrought iron, 25 ft. diameter and 95 ft. high; there are 18 sheets in the height, 14 being double riveted; the bottom sheets are ⅝ in. thick, the side sheets range from ⅝ in. at the lower to ¼ in. at the upper sheet. Its capacity is 330,480 galls. and it was built by Tiopet & Wood, of Philadelphia, N. J. The pipe system comprises 33.63 miles of pipe, 310 hydrants and 335 gates. The works are owned by the Racine Water Co.; President, HENRY E. COBB; Treasurer, A. B. TURNER; Secretary, J. E. DODGE; Superintendent, JAMES W. LYON.

Big Figure in Water Meters.—The National Meter Company, of 252 Broadway, N. Y., this last week celebrated the sale of their fifty thousandth (50,000) meter by giving a handsome dinner to their workmen at the shops in Brooklyn, at which, of course, many nice little self congratulatory speeches on the subject of water meters in general and *the* meter in particular were fired off by the orators of the occasion. President KELLY is an enthusiast on meters; he has an excellent machine and he knows it, and confining his energies to this one important branch of water-works machinery, he has eclipsed all competitors in the race for honors and emoluments desirable from his enterprise.

Filtering Plant.—The Water Committee, of Camden, N. J., opened proposals, Sept 9, for supplying the city with a filtering plant of a capacity of six million gallons daily. The bids were as follows: Philadelphia Water Filtering Co., $3,000, and $3 000 for each million extra daily; Hyatt Pure Water Company, $90,000 and $15,0 0 for each additional million gallons; National Water Co., $55,000, and $9 167 for each additional million gallons, and the Crocker Filtering Company, $27,460, and $4,500 for each additional million gallons daily.

South Framingham, Mass.—Mr. S. C. HEALD, C. E. of Worcester, Mass., in his report on the sewerage system endorses the opinions of Messrs. ELLIOT C. CLARKE and H. H. CARTER, but recommends that more ground be taken for the disposal of the sewage by irrigation, which method he considered the best for the purpose. The population of South Framingham is about 5 0 , and the volume of sewage to be dealt with will about equal the water supply, or from 3 0,000 to 400,0 0 gallons per day. He estimates that the system he proposes will cost in round numbers $140,000, and this estimate includes the purchase of 85 acres of land near the Natick town line at $40 per acre, $11,30 additional to be expended for clearing the land and laying out the filtration acres proposed. The tract to be used for intermittent downward filtration will cover 10 acres, while 75 acres will be used for broad irrigation. It is estimated that the pumps, boilers, necessary houses and reservoir for holding the night flow, with the two miles of force main required, will cost $50,000.

Water Works Improvements and Extensions.—*Palmer, Mass.* The Palmer Water Co. will extend its pipes.——*Stoughton, Mass.* The cost of extending the system to cover Stoughton village fire district, building a pumping station at Knowles brook and putting in pipe and hydrants, would be about $130,000. The Stoughton Water Co., which owns the present works, would sell any part or all of franchise at a price to be determined by disinterested parties.——*Brooklyn, N. Y.* Chief Engineer VAN BUREN continues to emphasize the necessity of early action in the extension of the work. Three years will be occupied in construction and the city now depends on a wet season to maintain its supply.——*Flushing, N. Y.* The Board of Trustees will purchase a new Blake pumping engine, with a daily capacity of 2,000 000 galls., for $8,500.——*Atlanta, Ga.* The filters at the water works will soon be in operation.——*Columbia, S. C.* A new reservoir is to be built.——*Henderson, Ky.* The council has authorized the Water Commissioners to put in an additional duplex engine, with a daily capacity of 1,000,000 galls., and necessary boiler and appurtenances. The cost will be about $7,000.——*Litchfield, Ill.* The City Council has decided to extend the water system, and 3,000 ft. of pipe are already delivered. The original cost for the works was $75,000 and the extensions will cost several thousand dollars more. Work has been commenced.——*Lake, Ill.* Two plans are suggested for obtaining an increased supply, one for a 36 in. main and the other for a 5-ft. tunnel to the Hyde Park works. As the present supply is sufficient for immediate wants it is thought best to wait till the new works for Chicago are completed and then obtain a supply from that city.——*Lansing, Mich.* Several new artesian wells are to be driven for an additional supply.——*Oshkosh, Wis.* It is proposed to filter lake water supply by conducting through a channel filled with gravel.——*Lawrence, Kan.* Two Hyatt filters are to be put in.——*Terrell, Tex.* The water works are to be improved. Address J. L. TERRELL.

Proposals Open.

Railroad.—The Thomasville, Tallahassee & Monticello railroad, from Thomasville, Ga., south about 12 miles. H. S. HAINES, Chief Engineer S. F. & W. R. R. Savannah, Ga. September 30.

Paving.—Trap block and granite block, on seven different streets; about one city block on each street D. LOWBER SMITH, Acting Com. Pub. Works, 31 Chambers street, New York City. September 27.

Dredging.—For Pier, new 37, North river; about 15,0 0 cu. yds. Department of Docks, Pier "A," North river, New York City. September 23.

Building.—State Insane Asylum at Hastings, Neb. Building complete including, plumbing, steam heating, ect. G. M. LAWS, Secretary Board of Public Lands and Buildings, Hastings, Neb. September 25.

Dredging.—In Pocomoke river, Md. WM. F. SMITH, U. S. Agent, Wilmington, Del: September 28.

Iron Roof.—Engine house roof at Chestnut Hill pumping station. H. T. ROCKWELL, Chairman Boston Water Board, City Hall, Boston, Mass. September 26.

Street Improvement.—Grading, Macadamizing, and constructing Telford pavement on several streets. HENRY FLAD, President Board of Public Improvements, St. Louis, Mo. September 22.

Dredging.—The following bids for dredging in Cape Fear river N. C., were opened Sept. 5, by W. H. BIXBY, Captain of Engineers, Bittenhouse Moore Mobile, Ala., 13⅞ cts. per cu. yd., scow measure. Atlas Dredging Co. Wilmington, N. C., 13⅞ per cu. yd., scow measure.

Grading and Masonry.—Constructing Cedar avenue, Baltimore, Md. About 5,300 cu. yds. of earth and 1,500 perches of masonry. WM. H. SHIPLEY, 12 Morse Building, 2 9 E. Fayette street, Baltimore. September 24.

Sewers—Pipe and Laying.—at Sault Ste. Marie, Mich. About 9,800 ft. of pipe sewer. WM. CHANDLER, Secretary Board of Sewer Commissioners, Sault Ste. Marie, Mich. September 24.

College Buildings.—Dormitory, Apartment building and Laboratory. Plans at office of Wm. P. Appleyard, Lansing. HENRY G. REYNOLDS, Agricultural College, Mich. September 29.

Water-Works.—For the town of Columbia, Mo. Population, about 4,000. G. W. HENDERSON, Chairman of Committee, Columbia, Mo. October 3.

Dredging.—In the ship channel at Galveston harbor; about 1.200.000 yds. Major O. H. ERNST, U. S. Engineer's office, Galveston, Tex. October 1.

Road.—2800 feet macadamized road; width 15 ft. depth 6 in. JOHN D. BELMER, Chairman Street Committee, Rahway, N. J. October 15.

Stone Roads.—At Toledo Insane Asylum. H. A. TOBEY, Secretary, Toledo, O. October 1.

Buildings.—Bath House and Industrial Building at above Asylum. Address as above. October 1.

Buildings.—Wood and iron work on Kansas State Reformatory at Hutchinson. J. D. R. SMITH, Secretary Board of State Reformatory Commissioners, Topeka, Kan. October 6.

Water-Works.—At Chihuahua, Mexico. The Mayor, DON JUAN ZUBIRAN. October 13.

Contracting.

Stone.—The city of Syracuse N. Y., has awarded a contract for two cords of hard limestone, sizes suitable for breaking by a stone crusher, delivered on board cars at the crusher, to A. E. ALVOLD of Syracuse at $2.41 per cord.

Capt. W. H. BIXBY of the U. S. Engineers opened proposals Sep. 1 for 5000 tons stone for the work on Cape Fear river, N. C.—— Prices per ton delivered at the works. JOHN S. HOWELL, New York, $2,17½. GEO. F. FRENCH, Rock Point, N. Y., $1.84½.

Piers.—For the new piers at the South Ferry, East Boston side, the Board of Directors of the East Boston Ferries received the following bids: McInnis & Parker, $12,9 8; Wm. A. Norton, $13 000; I. N. Hayes & Co., $14,250; W. A. Hendricks, $14 670.

Bridge.—Proposals were opened Sept. 10, at the office of the Detroit Board of Public Works for the Belle Isle bridge. The following bids were received: Keystone Bridge Company, Pittsburg, Pa., $375 650; George Farwell, Detroit, $335,000; Detroit Bridge & Iron Works, $330,000; King's Iron Bridge Company, Cleveland, $343,000; Morse Bridge Company, Youngstown, O., $360,000; Milwaukee Bridge Company, four propositions, as follows: $287,000, $ 05,000, and two at $295,000, their highest proposition being $30,000 lower than the lowest of any of the other bidders.

Rip-Rap Wall.—The following bids for building a stone wall of about 28,000 cu. yds. at Aransas Pass Tex., were received by Major O. M. ERNST, U. S. Engineer:

	Per cu. yd.
Gus Wilkie and John W. Bickey, Austin	$3.89
Louisiana Jetty & Lightering Company, New Orleans, La.	3.00
T. H. Mi kejohn, San Antonio, Tex	3 18
Charles Clarke, Galveston, Tex	3.35
A. M. Shannon & Co., Galveston, Tex	2.95

Grading.—The County Commissioners of Douglas Co., Neb., recently opened bids for constructing a road, for which about 3 500 cu. yds. were to be moved. The bids were as follows per cubic yard: W. F. Fynn, 17¼ cts.; C. W. Finn, 23 cts.; H. Hall, 14⅞ cts., McKinney & Brown, 19¼ cts.; Oliver Honey, 18 cts.; Harry Fairfield, 20 cts.; Silas Bain, 17½ cts.; Louis Thomas, 13 cts., Black & McCann, 17½ cts. Thomas' bid being the lowest, he received the contract.

Schedule of Bids for the Sewerage of Englewood, N. J., opened Sept. 3, 1887.

ITEMS.	AMOUNT OF WORK	Successful, HOLMES & COGAN, Jersey City, N.J.		VAN KEUREN & HALLIDAY, Jersey City, N.J.		AUSTIN & CARTWELL, Bridgeport, Conn.		WM. E. DEAN, N. Y. City.		D. L. BARRETT, Englewood, N. J.		SOHN SALTERLEY, Englewood, N. J.		SMITH & BRODIE, Long Island City, N. Y.		R. B. SLOAT, Highwood, N. J.		JAS. A. ROONEY, Paterson, N. J.	
		Price	Total.	Price	Total.	Price	Total.	Price	Total.	Price	Total.	Price	Total.	Price	Total.	Price	Total.	Price	Total.
12 in.,	4,793 ft.	.55	2,636.60	.60	2,875.20	.87	2,731.44	.70	3,354.45	.85	4,073.20	.85	4,073.20	.65	3,114.80	.90	4,312.80	.84	4,025.28
10 in.,	1,938 "	.52	1,39.76	.55	570.90	.80	519.00	.70	726.60	.80	830.40	.75	778 50	.74	768.12	.80	830 40	.84	871.92
8 in.,	3,042 "	.42	1 277.64	.34	1,186.38	.45	1,368.90	.54	1,642.68	.60	1 8 5.20	.60	1,825.20	.55	1,673.10	.80	2,433.60	.70	2 129.40
6 in.,	23,125 "	.29	6,416.25	.32	7,080.00	.35	7,743.75	39	8,628.75	.50	11,062.50	.50	11,062 50	.50	11.0 2.50	.65	14,381.25	.60	13,275 00
12 in. Y.'s,	20	1.06	21.20	1.50	30.00	2.00	40.00	1.25	25.00	1.60	32.00	2.00	40.00	.75	15.00	.90	18.00	3.72	64.40
10 in. Y.'s,	20	.82	16.40	1.14	22 80	1.50	30.00	1.25	25.00	1.50	30.00	1.75	35.00	.84	16.60	.80	16.00	2.97	59.40
8 in. Y.'s,	60	.56	33.60	.79	47.40	1.00	60.00	1.25	75.00	.90	54.00	1.20	7 .00	.56	33.60	.80	48.00	2.25	135.00
6 in. Y.'s,	200	.40	80.00	.52	104.00	.67	134.00	1.25	250.00	.70	140.00	.85	170.00	.38	76.00	.65	130.00	1.72	344.00
Manhole, ver. ft.,	450 ft.	3.50	1,800.00	4.50	2,025.00	5.00	2,250.00	3.50	1,575.00	3.90	1,755.00	4.50	2,025.00	6.50	2,925 00	4.00	1,800.00	4.50	2 025.00
Flush tanks,	15	42.	630.00	50.	750.00	53.	795.00	60.	900.00	45.	675.00	45.	675.00	60.	900.00	30.	450.00	75.	1.125.00
Iron work,	30,000 lbs	.03½	1,050.00	.04	1,200.00	.02½	825.00	.03	900.00	.04	1,200.00	.05	1,500.00	.05	1,500.00	.03½	1,050.00	.04	1,2 0.00
Trap rock,	0	3.00	0.	4.00	0.	5.00		5.00	0.	2.00	0.	3.00	0.	3.50	0.	4.00	0.	5.00	0.
Sand stone,	500 yds	2.00	1,000.00	2 50	1,250.00	8.00	2,500.00	1.25	625.00	1.50	750.00	2.00	1,000.00	3.00	1,500 00	2.50	1,250.00	4.00	2,000.00
Concrete,	100 "	3.50	350.00	4.00	400.00	6.00	600.00	5.00	500.0	7.00	700.00	6.00	600.00	2.50	250.00	2.75	275.00	5.00	500.00
Timber, B. M.,	10 M.	22.	220.60	22.	220.00	22.00	220.00	22.	220.00	22.	220.00	22.	220.00	22.	220.00	22.	220.00	22.	220.00
Totals.....			$16,070.45		$17,761.63		$19,217.09		$19,447.43		$23,347.30		$24,276.40		$24,054.72		$27,215.05		$27,974.40

Extras at Engineer's estimate.

C. PH. BASSETT, Engineer-in-charge.

Dennis Long & Co., of Louisville, Ky. have increased the capacity of their pipe works.

Well.—The Knoxville Natural Gas Co., of Knoxville, Tenn., has awarded a contract for sinking a well to the American Well Drilling Co., Louisville, Ky.

Canal.—The contract for the canal for the new waterworks for the Elyton Land Co., Birmingham, Ala., has been awarded to F. H. Gafford.

The Chicago & Arkansas Construction Co. has been incorporated at Chicago, Ill., by JOSEPH FLEISCHMANN, GEORGE M. BARBOUR and ADOLPH CUDELL, to undertake the construction of railroads, etc. Capital stock, $500,000.

Stone.—The contract for furnishing the stone for the piers of the Illinois Central R. R. bridge at Cairo, Ill., has been awarded to Loss & Wilson, of Rochester, N. Y. The stone is quarried at Bedford, Ind.

Street Lighting.—The following proposals for furnishing gas for the street lamps of the city of Boston were opened Sept. 1 by the Superintendent of Lamps:

East Boston Gas Co.	$1.65
Charlestown Gas Co.	1.65
South Boston Gas Co.	1.65
Roxbury Gas Light Co.	1.65
do exceeding 15 ft. per hour.	1.30
Dorchester Gas Light Co.	2.00
Jamaica Plain Gas Light Co.	2.00
Brookline Gas Light Co.	2.00

Sibley Bridge.—About 1800 linear ft. of iron viaduct, constituting the approaches to the bridge for the Chicago, Santa Fé & California R. R. over the Missouri river at Sibley, have just been erected by FRED. H. SMITH of Baltimore, Md. The structure was put in place by the aid of a specially designed traveller, 80 ft. high.

Levee Work.—The following bids were opened Sept. 3, by the Board of State Engineers at New Orleans, La.

Hollywood, Parish of East Baton Rouge—R. McNamara bid 18 cts. per cu. yd., P. Byrne 14 cts. M. Head 16¾ cts. P. J. Tyrrell 16¾ cts. M. B. McGarry 17 4-9 cts.

Greenwood, Lafourche Parish—George Dionne 24 cts. P. Harnan, 23¾ cts. Wm. Dowling 22½ cts.

Aubert Hebert and Leighton, Lafourche Parish—George Dionne 23 cts. P. Harnan, 24 cts.

Blake, Parish of Lafourche—P. Rousseau, 29¾ cts.

Guidroz, Lafourche Parish—Barrios and Toups 20 cts. P. G. Alemon, 20 cts. M. Robichaux 19¾ cts.

Pelican, St. Charles Parish—John Cleary 17 cts. R. McNamara 17 cts. P. Byrne 15 cts. M. Head 16¾ cts. P. J. Tyrrell 16¾ cts. M. B. McGarry 15 7/8 cts.

The bids were referred to the governor for adjudication. The lowest in each instance being recommended for acceptance.

Metal Work.—The following proposals for metal work for the lighthouse at Harbor island, N. C., were opened Sept. 3 by Capt. J. C. MALLERY, U. S. Lighthouse Engineer (5th District), Baltimore, M. D.: Allentown Rolling Mills, Allentown, Pa., $5,600; Colwell Iron Works, New York City, $5,698.77; Phoenix Iron Co., Trenton, N. J., $6,000; West Point Foundry Association, Cold Spring, Y. N., $6,230; H. A. Ramsey & Son, Baltimore, Md., $7,950.

Dredging Etc.—The following proposals for making a channel from the great Salt Pond to the ocean, at Block Island, R. I., have been received by H. S. MILLIKIN: S. V. R. Hendrick, Easthampton, Mass., $8,450; John Van Patton, Albany, N. Y., $9,350; C. H. Edwards, Boston, Mass., $9,394; Frank Pigeon Dredging Co., New York, $9,600; Hartford Dredging Co., Hartford, Conn., $16,900. The contract was awarded to S. V. R. Hendrick.

Sea Wall.—The following proposals for a sea wall in the Roxbury canal have been received by the Water Board, Boston, Mass.: Boynton Bros., of Boston, $9,974; C. T. Derry, & Co., of Boston, $10,997; Jos. H. White of Boston, $11,391; F. C. Whitcomb, of Boston, $11,576; Charles H. Edwards, of Boston, $11,778.80. The contract was awarded to Boynton Bros.

Levee.—A levee to protect the city of Augusta, Ga., from high water is to be built at a cost of $50,000.

Plumbing.—The following bids were received for renewing and repairing the plumbing, etc., in the Custom House and Post Office at New Orleans, La.:

Bidder.	Custom House.	Post Office.
Manion & Co	$4,380	$1,400
H. W. Boettner	5,640	2,430
Bulger & Briedy	6,997	2,2 0
F. J. Gremley	6,300	2,390
Lyons, Kirby & Knight	6,860	2,250

Both contracts were awarded to Manion & Co.

Pier.—The following proposals have been received by the Dock Commissioners, New York City, for building the new pier at W. 37th street: John Gillies, $23,600; P. Sanford Boss, $27,300; John W. Flaherty, $29,725. The contract was awarded to John Gillies. The Dock Department will furnish 357,355 ft. of yellow pine timber. The pier is to be completed in December.

Pipes and Castings.—The following proposals for water pipe and castings were received Sept. 1, by the Board of Water Commissioners, Yonkers, N. Y.: Warren Foundry and Machine Co., Phillipsburg, N. J.: 6 in. and 4-in. pipe, $36.50 and $39 per ton; specials, 2¾ cts. per pound; total, $1,187.50. John Fox, New York: pipe, $36.50 and $37.50 per ton; specials, 2¾ cts. per pound; total, $1,192.50. Jackson & Woodin Manufacturing Co., Berwick, Pa.: pipe, $36.50 and $39 per ton; specials, 2¾ cts. per pound; total, $1,200. Florence Iron Works, Philadelphia, Pa.: pipe, $37 and $37.50 per ton; specials, 3 cts. per pound; total, $1,227.50. M. J. Drummond, New York, pipe, $39 and $41 per ton; specials 3 cts. per pound; total, $1,285. The contract was awarded to the Warren Foundry & Machine Co., of Phillipsburg, N. J. J. A. Lockwood is Superintendent of the water-works.

Bridge Piers.—The following proposals have been received by the Board of Public Improvements, St. Louis, Mo., for constructing the unfinished portion of the main piers of the Grand avenue bridge, and building with said piers, the iron work necessary for the connection with the superstructure: Black & Davis 650 cu. yds. of underground masonry, $6.50 per cu. yd.; 1,200 cu. yds. of masonry above ground, $15.90 per cu. yd.; 100 cu. yds. of granite courses, $42 per cu. yd.; 12,000 pounds of iron work in position, complete, $700; total, $28,205. Fred Hoffmann; $5.45; $16.70, $44, $650; $28,632.50. McCully Stone, Mason Co., $7; $16.75; $44; $500; $29,550. Edward Reiley, $8,50, $17.50, $44, 72, $30,997. Fruin Bambrick Construction Co., $6.90, $19.90, $45, $1,000, $33,905.

The Berlin Iron Bridge Co., of East Berlin, Conn., is now very busy on bridge and other iron work. It has under construction 3 single track bridges for the Naugatuck division of the New York, New Haven & Hartford R. R., and 7 four-track bridges for the New York division, which are parts of the four-track work which the Consolidated road is pushing. It has also the contract for all the bridges on the Meriden & Waterbury R. R., about 36 in number; and 4 spans of single track for the Housatonic R. R. It has nearly half a mile of arcade to build for the Consolidated road to cover the new stations on the New York division. In highway bridges it has contracts on hand for 23 spans, of varying length, from 22 ft. to 240 ft. Recently it shipped the ironwork for a bridge at Fairfield, Me., 240 ft. long, and also 12 other smaller bridges in one week. Some of the larger bridges are—a 240-ft. span at Massena, N. Y.; a 220-ft. span at Milford, Vt., and a 220-ft. span at Highgate, Vt. An iron roof has just been completed at Ansonia, Conn., which required 22 cars for its transportion. In iron buildings it is also doing a heavy business, having two iron buildings to put up for the Seymour Copper Co. Co. Seymour; one for the Waterbury Brass Co., Waterbury; one for the Stanley Rule & Level Co., New Britain, and another for the City Water Works, at Burlington, Vt.

Bridge Repairs.—The contract for repairing the Kansas & Missouri R. R. bridge at Leavenworth, Kan., has been awarded to the Milwaukee Bridge & Iron Works, Milwaukee, Wis. The work will be very thorough and the estimated cost is $64,000.

RAILROADS.

East of Chicago.

Existing Roads.—*Pontiac Pacific Junction.*—Ten miles of the extension of this Canadian road are now under construction by S. JOHNSON, the contractor, from Coulonge river to the mouth of Black river. From this point to Pembroke, 23 miles, the line has been located, crossing Allumette Island and the two channels of the Ottawa river, and will be built next season. The bridge over the Coulonge river is being built by the company. The east abutment is completed and work is in progress on the pier foundations. The parties backing the company propose an extension to Sault Ste. Marie, which seems to indicate a present or probable alliance with the Grand Trunk.

Pennsylvania.—The Cumberland & Maurice river branch of the West Jersey road is being rapidly graded and will be open for business in time for the Fall oyster traffic.

Central Vermont.—The extension from Barre to Williamstown, 6 miles, mentioned last week, will eventually be pushed on south to Royalton, about 25 miles, and this will be made the main line of the company, thus avoiding the heavy grades on the present line at Roxbury and bringing Montpelier on the main line.

Boston & Maine.—The battle in the New Hampshire legislature is growing more and more exciting. Direct charges of bribery have been preferred and an investigation is in progress. The greatest sensation, however, was caused by the announcement of Representative HAZEN, of Whitefield, who introduced the bill in the Boston & Maine interest, that he should cease to advocate the bill which bears his name and should vote and work for the ATHERTON bill, which is in the interest of the Concord company.

Baltimore & Ohio.—Messrs. JOHN A. HAMBLETON & Co., financial mouthpieces of President GARRETT, have issued a statement of the company's affairs stating in effect that the cramped financial condition of the company is not due to faults of the present management, but rather to the ambitious schemes of the former president. Whether it is a valid defense of ROBERT GARRETT'S reputation for business sagacity to say that he attempted to carry out the plans of his father and made a failure of it, we leave those who are acquainted with the history of the elder GARRETT'S life to judge for themselves.——About every prominent railroader in the east has been "named" for the B. & O. presidency, and plenty of statements are in circulation to the effect that there will be no change in that office. But as Mr. GARRET wishes to be rid of the responsibility, it is quite probable that the new syndicate, in view of his brilliant moves of the past few months, will be willing to excuse him.

Pittsburg & Western.—The reorganization of this company leaves it in an excellent condition, and extensive improvements are to be undertaken on the present line. The projected extensions in connection with the Baltimore & Ohio are held in abeyance until some settled state is arrived at in the shifting affairs of the latter company. It is stated, however, on authority of SOLON HUMPHREYS that a project is under consideration for a connection with the Wabash by a line from Akron, O., west to Huntington, about 130 miles. This, however, is probably a good way in the future.

Cincinnati, Hamilton & Dayton.—As a result of the operations of the IVES-STAINOR gang, a petition has been filed for the appointment of a receiver for this company.

Terre Haute & Indianapolis.—It is reported that the treasury of this road is a little less than $2,000,000 short

as a result of its connection with the "young Napoleon of finance" mentioned above.

New Projects and Surveys.—*Fort Plain & Richfield Springs.* The preliminary survey of this New York road 28 miles in length has been completed and right of way obtained at a controlling point of the route. Nothing more will be done this year. WM. CLARK of Fort Plain is President, and J. M. FARLEY is Chief Engineer.

Mohawk & Susquehanna.—This is the opposition project to the preceding, and surveyors are still at work endeavoring to find a feasible route in place of the one where the Fort Plain company have obtained possession. The backers of these two projects will probably come to an amicable settlement during the winter and a compromise line will be built next season.

Fort Plain, Ephratah & Northern.—This project, which went as far as making surveys a score of years ago, is to be revived. Maps of the old survey will be filed and a company formed and it is thought that work will be undertaken next season.

Boothbay.—A company is to be organized at Boothbay, Me., this month, to build a railroad from that point to a connection with the Knox & Lincoln R. R. at Wiscasset or Damariscotta, about ten miles. The line will probably be built next summer. CHAS. H. FISHER of Boothbay is interested.

Binghamton & Southwestern and Williamsport & Northwestern.—These two companies proposed a railroad from Binghamton, N. Y., to Williamsport, Pa., about 100 miles. The line was located last winter, the portion from Vestal, N. Y., to Wyalusing, Pa., 40 miles, by A. P. BOVIER of Elmira. On this portion of the line max. grades are 45 ft. and curves 6°, except two of 7°. It is stated that right of way has been mostly secured for the line. JOS. P. NOYES of Binghamton is President.

New Lisbon, East Liverpool & Southern.—This Ohio company proposes a line from New Lisbon to East Liverpool on the Ohio river, about 15 miles. DANIEL CRAWFORD is President. The project will be backed by the Nypano.

Vincennes, Oakland City & Owensboro.—This company has been organized to build a railroad from Vincennes, Ind., to Owensboro, Ky. J. C. RUDD, of the latter city, is President.

Southern.

Existing Roads.—*Chattanooga, Rome & Columbus.*—This road, on which grading has recently begun, is to be a link in a direct line from Chattanooga, Tenn., to Tallahassee, Fla., a distance of about 400 miles. At Columbus, the Southern terminus, connection is made with the Birmingham, Georgia & Florida running *via* Cuthbert and Bainbridge to Tallahassee.

Kingwood.—This West Virginia road, 10 miles in length, which was finished ready for the iron last year, is to be at once completed and put in operation. GEO. M. WHITESCARVER of Grafton is interested.

Norfolk & Western.—This company contemplates an extension of its Cripple Creek branch to Mt. Airy, N. C., the present terminus of the Cape Fear & Yadkin Valley R. R.

Maysville & Big Sandy.—Grading is practically finished on this extension of the Huntington system from Ashland to Maysville, Ky. The large bridges on the line have delayed the completion of the work.

Kentucky & South Atlantic.—This road, 20 miles in length, from Mt. Sterling to Rothwell's, Ky., has been sold and will form part of the Huntington system.

Tennessee Midland.—Contractors are making rapid progress on the western division of this road, 135 miles in length, now under contract. Davidson County is asked for a bonus of $500,000 by the company and will probably give it.

Covington & Macon.—This Georgia enterprise is again in financial hot water and much doubt exists as to whether the line will ever be completed.

Birmingham & Atlantic Air Line.—The application for a charter for a parallel line to the Savannah, Dublin & Western division, now under construction, has been denied by the Georgia legislature.

Blue Spring, Orange City & Atlantic.—It is reported that the backers of this company will build at an early day an extension west to Tavares.

New Projects and Surveys—*Eufaula & St. Andrews Bay.*—A preliminary survey of this road has been made from Eufaula *via* Lawrenceville, Abbeville, Dothen and Chipley to St. Andrews Bay, 147¾ miles. Further surveys will probably be made this fall. Col. W. N. REEVES, Eufaula, Ala., is President.

Hiawassee.—Surveys are in progress on this line projected from Hiawassee, Ga., to Chattanooga, Tenn., HENRY E. COLTON is President and Chief Engineer.

East & West.—This company has been organized in Tennessee to build from a point on the Cincinnati Southern in Scott or Morgan counties to Cartnage, with branches to connect with the Tennessee Midland Ry. in Cumberland county, and to the coal fields near the Kentucky line. C. E. JAMES, of Chattanooga, is interested.

Wheeling, Wellsburg & State Line.—This company is to be organized Oct. 6 at Wellsburg, W. Va., to build a line from Wheeling through the West Virginia panhandle to connect with a direct line to Pittsburg.

Clearwater & Tampa.—This company has been organized at Tampa, Fla. S. A. JONES is interested.

Norfolk & Columbia.—This is a projected road from Norfolk, Va., to Columbia, S. C. The head office of the company is located in this city. SAMUEL CONOVER is President.

The Northwest.

Existing Roads.—*Illinois Central.*—The Decatur & Western Nebraska Company, whose incorporation we noticed last week, is now stated to have been organized in this company's interest and is indicative of the surprisingly bold extension policy which this long conservative company has all at once adopted. Report says that President CLARKE himself is out with a party journeying over the Nebraska plains and is bound to Salt Lake City. The extensions under contract are being pushed at a remarkable rate. The 60 mile extension from Cherokee to Onawa is nearly graded and trains are to be running to Onawa not much after the 1st of October. From Onawa the line is to be pushed to the Missouri river, which will be bridged at Decatur and a line will also be built at once from Onawa to Council Bluffs and Omaha.

Red River Valley.—Notwithstanding various rumors that the Provincial Government is finacially straitened, and that Premier NORQUAY had been unsuccessful in his attempts to float the bonds of the Province in New York, the Manitobans do not seem to have arrived at the end of their rope and the work of building the road goes merrily on. Rails for fifteen miles of the line have been bought, paid for, and forwarded from Montreal, and will be put down at once. The Dominion Government has "shown its hand," and the Attorney General has filed bills against the Manitoba Ministers and the contractors who are building the road. It seems hardly likely that the work will be allowed to stop for lack of funds, for some of the United States corporation who will be benefited by its construction would back the enterprise secretly rather than have it fail.

Chicago & Northwestern.—Work is nearly finished on the extension from Verdon, Dak., to Groton, on the Chicago, Milwaukee & St. Paul.

St. Paul & Duluth.—A rumor which needs confirmation, states that this company contemplates an extension from St. Paul southwest to Omaha, and that surveyors are already in the field.

St. Paul, Minneapolis & Manitoba.—The final location of the line from Milaca, Minn., to Brainerd, is completed, and it is thought the line will be graded this Fall. Surveying parties are now working on the line from Brainerd northwest *via* Leech lake and Lake Itasca to a connection with the Crookston & Southwestern line. This portion will probably be pushed to completion next season, opening up the lake region about the headwaters of the Mississippi, heretofore far removed from railroads.——Tracklaying is finished on the extension from Benson, Minn., to Watertown, Dak., a distance of 92.211 miles.

St. Louis, Alton & Terre Haute.—The second division of the Chicago, St. Louis & Paducah Railway has been located 15 miles in length, and the contract for the grading has been awarded to N. W. Irish, of Carlyle, Ill. The 15 miles now under contract is well under way, the first 10 miles from Marion to Creal Springs being ready for the track-laying, which was commenced Sept. 3 at Marion, by Anderson, Beadley & Co., the contractors. It is intended to have the whole line from Marion to Brooklyn, opposite Paducah, under contract this Fall. Col. E. W. MUENSCHER is Chief Engineer.

New Projects and Surveys.—*Quincy & Rock Island.*—This company has filed articles of incorporation in Illinois to build a railroad between the points named. CHAS. A. MCLAUGHLIN, of Galesburg, is interested.

Duluth, Red Wing & Southern.—This Minnesota project has secured a considerable amount of stock subscriptions, and a committee has been appointed to come to this city and secure further funds. F. W. HOYT, of Red Wing, is President.

The Southwest.

Existing Roads.—*Atchison, Topeka & Santa Fé.*—It is firmly asserted and denied that the company has absorbed the St. Joseph & St. Louis road, extending from St. Joseph to Lexington Junction, Mo., a distance of 76 miles.——The following is the statement by the construction department of the track laid in the first eight months of this year:

Extension.	*Miles.*
Great Bend	67.5
Augusta	20.8
Mulvane	80.8
Colony	13.6
Ellinore	7.1
Arkansas City	28.3
Larned	22.4
Benedict	27 5
Girard	1.1
Kiowa	135.5
Burlington	10.9
Strong City	20 3
L., N. & S. Ry	45.6
D. & S. F. Ry	68.6
C., S. F. & C. Ry	35.0
C., S. F. & C. Ry., of Iowa	35.1
Total	746.1

Central Missouri.—A new rumor in connection with this road is that it is backed by the Chicago, Milwaukee & St. Paul, which desires an entrance to St. Louis, and is to obtain it over this line.

St. Louis, Arkansas & Texas.—The contractors are making good progress on the 50 mile extension from Altheimer, Ark., to Little Rock, and it is hoped to have trains running by December 1. On the extension from Corsicana to Hillsboro, Tex., about 25 miles are graded and tracklaying is in progress. It is stated that the company has determined to have direct connections with a Gulf port at an early date.——The Kansas & Gulf Short Line, which is now owned by the company running from Tyler to Lufkin, 90 miles, will be changed to standard gauge and extended 44 miles to Rockland, the terminus of the Sabine & East Texas branch of the Southern Pacific, running to Sabine Pass, 104 miles. The harbor at Sabine Pass is said to be one of the best on the Gulf, and if the scheme as outlined is carried out, will be improved by the erection of locks and terminals so that a large traffic may be handled.

Kansas City, Wyandotte & Northwestern.—A large force is at work grading this line between Oskaloosa and Seneca, Kan.

Missouri Pacific.—Grading is making good progress on the Dallas & Hillsboro (Tex.) line, and it is stated that a line will soon be put under way from Milford to Waco, leaving the 20 miles from Milford to Hillsboro to be operated as a branch line.

New Projects and Surveys.—*Kansas, Missouri, Arkansas & Natchez.*—This company has filed its charter in Kansas and proposes a railroad from Cherryvale, Kan., to Natchez, Miss., a distance of 500 miles. A. W. BENTON, of Neosho, is one of the incorporators.

Memphis Arkansas & Kansas.—The line of this proposed road is from Memphis, Tenn., to Galena, Mo., *via* Forrest City, Searcy and Harrison, with a branch to Little Rock. It is stated that the scheme is backed by the Richmond Terminal company and that work will begin Dec. 1, all of which may be true, but—

Rocky Mountain and Pacific.

Existing Roads.—*Northern Pacific.*—Tracklaying is completed on the Drummond & Philipsburgh line in Montana, 26¼ miles in length.——Graders are to begin work at once on the Rocky Fork & Cooke City road.——On the Spokane and Palouse Ry., in eastern Washington Territory, 60 miles of grading are completed, the bridging is well advanced and tracklaying is in progress.——The struggle between the present management, headed by President ROBERT HARRIS, and the VILLARD-SMITH-COLBY syndicate is noted upon our "Engineering News" page.——A correspondent of the New York *Times*, who has been visiting the Coeur d'Alene mining region, declare that its extravagant claims are not well supported and predicts its early collapse. The same writer recently gave a most favorable report of the Montana mining districts. Should his views be correct it will be well for the Northern Pacific that it has "gone slow" in the matter of the Coeur d' Alene craze; and its work of the present year in Montana will prove remarkably fortunate.

Union Pacific.—The Idaho Central line 20 miles in length, from Nampa to Boise City the capital of the Territory has been completed and opened for traffic. It is said that negotiations are in progress for a division of territory and mutual understanding between this company and the Northern Pacific to avoid paralleling each other's extensions. If the VILLARD-SMITH Syndicate obtains control of the Northern Pacific, the lease of the Oregon & Railway Navigation company's lines will probably be held equally by the two companies.

Oregon & Washington Territory.—Grading is nearly completed on this line, 35 miles in length, from Pendleton, Ore., to Wallula, W. T.

Atchison, Topeka & Santa Fé.—The periodical batch of rumors regarding the San Francisco extension, is at hand, and differs but little from those in circulation a few weeks ago.

Colorado Midland.—Regular trains are now running between Colorado Springs and Leadville. An $80,000 union (?) depot is to be built by the company in connection with the Santa Fé.

New Projects and Surveys.—*San Diego & Julian.*—This company has been organized at San Diego, Cal. R. W. WATERMAN is President, and T. J. DALY, Secretary.

Los Angeles, San Jacinto & San Diego.—It is reported that a company is to be formed to build a line upon the route indicated by the above title, a distance of 250 miles.

San Francisco, Clear Lake & Humboldt.—Some grading has been done on this line to hold the right of way through Butt's canyon, and it is stated that contracts will be let very soon for work on the whole line. W. H. H. HART, of San Francisco, is President of the company.